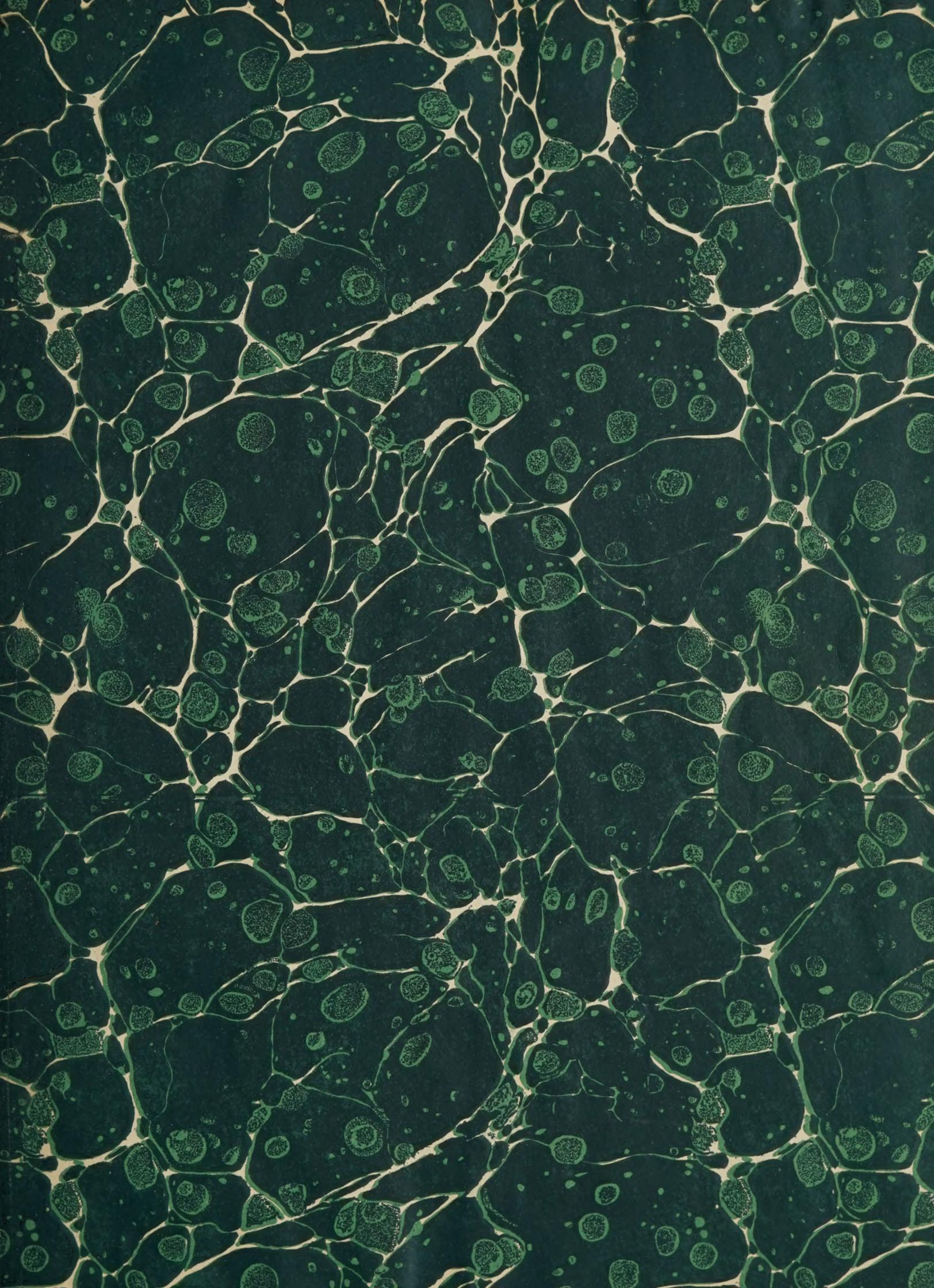


PROPERTY
OF
PUBLIC ROADS ADMINISTRATION
LIBRARY



Book No. C.4



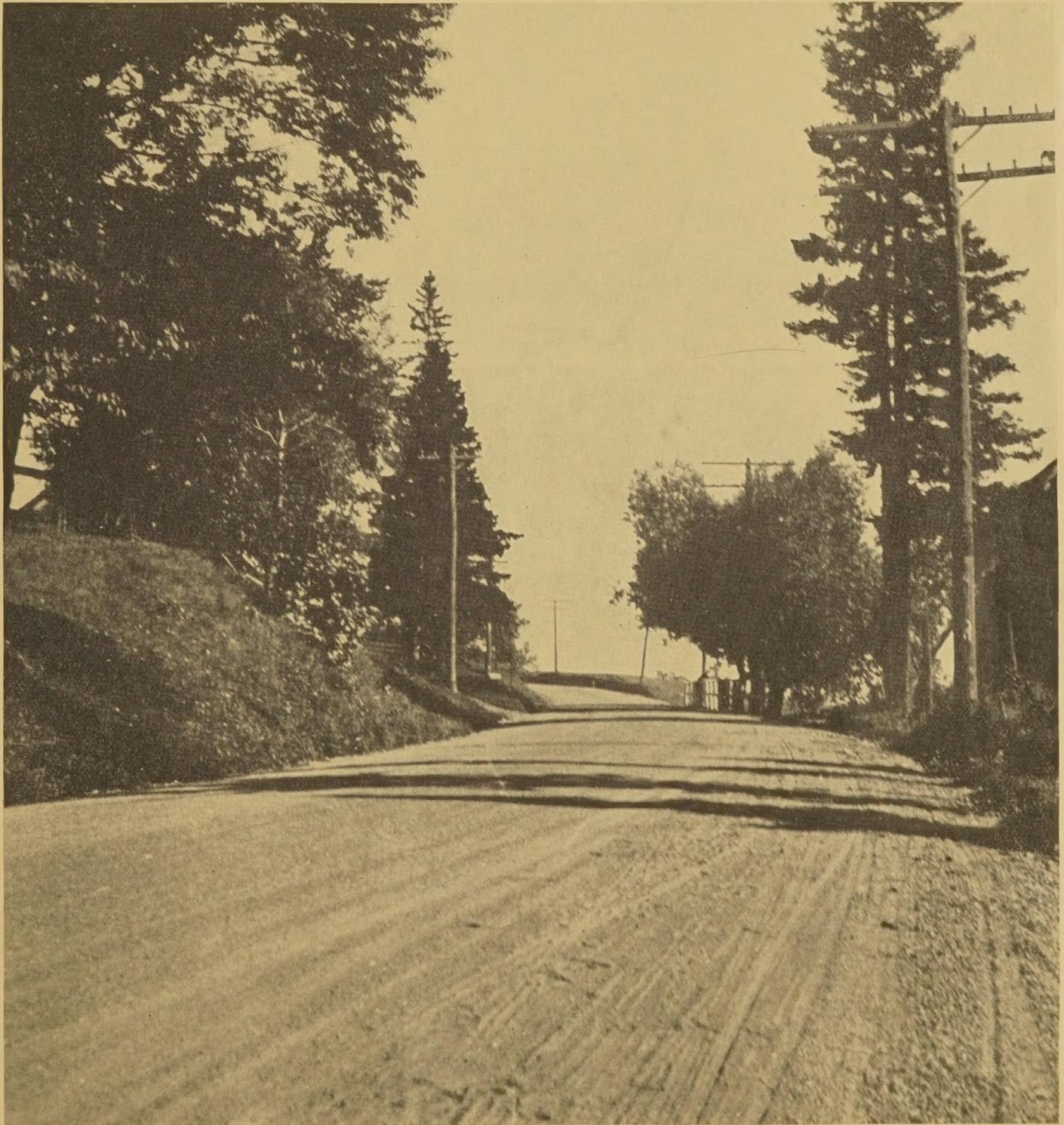
U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

Public Roads

VOL. 4, NO. 4

WASHINGTON, D. C.

AUGUST, 1921



NEW HAMPSHIRE FEDERAL-AID PROJECT NO. 70

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
10 CENTS PER COPY
SUBSCRIPTION PRICE, \$1.00 PER YEAR

U. S. DEPARTMENT OF AGRICULTURE

BUREAU OF PUBLIC ROADS

PUBLIC ROADS

TABLE OF CONTENTS

	Page
Federal Bureau to Make Survey of Road Mileage and Revenues	3
Semi-Permanent Guard Fence Built on Federal-Aid Roads <i>C. L. McKesson</i>	15
Direction and Warning Signs are Standardized in England	17
Maryland Markers Explain Laws and Protect Travelers <i>Harry D. Williar, jr.</i>	20
Fine Particles Removed From Sand by Centrifugal Blower <i>C. H. Sweetser</i>	22
Grading to Help Nature Clear the Roads of Snow <i>B. B. Hauser</i>	23
Status of Federal Aid June 30, 1921	24
Federal-Aid Allowances	26



THOMAS H. MacDONALD	Chief of Bureau
P. ST. J. WILSON	Chief Engineer
H. S. FAIRBANK	Editor

FEDERAL BUREAU TO MAKE SURVEY OF ROAD MILEAGE AND REVENUES.

THE Bureau of Public Roads has just launched a project to ascertain the total mileage of rural as well as urban highways in the United States, the character and extent of their improvement, the expense incident to their construction and maintenance, the origin and disbursement of the funds for highway purposes and details of administration under which the work of improving the Nation's highways is carried out. Similar surveys but not as extensive were made by the Bureau in 1904, 1909, and 1914.

The present survey differs from those of the previous years in that it will not only embrace the rural roads, outside of incorporated villages and cities, but also the urban highways such as streets, roads, and alleys inside of all incorporated places having a population of 2,500 or over.

THE NEED FOR A SURVEY.

The need for such a survey is most urgent. The whole matter of Federal cooperation in road construction is now under consideration in Congress. While there are a number of conflicting opinions as to the methods which should be adopted by the Government, it is practically certain that future Federal participation will be limited to a small percentage of the roads of the country. To provide a basis for future action by the Government it is imperative that an accurate picture of the present highway situation be obtained both with respect to the whole field to be covered and also as to the part of the work that has already been done.

From the standpoint of the States and local communities themselves it is highly desirable to collect for purposes of reference, information as to the methods of administration and financing employed by every community. The States have set out to build extensive State road systems; counties and local communities are voting large amounts of bonds and taxing themselves to the limit in order to raise funds for the betterment of their roads. In the main, each State and each community is proceeding to the solution of its own local problems with no conception of what the other is doing. Every State and every community will gain by a better knowledge of what is being done elsewhere, particularly in respect to methods of administration and financing. Common council is a wonderful solvent of difficulties, and the survey which is being undertaken will serve as the means for an interchange of ideas which should be most beneficial to every community and to the Nation as a whole.

OBJECT OF THE SURVEY.

The present survey aims to determine not only how much money we are spending on our roads, and from what sources our road revenues are derived, but also what results are secured from these expenditures.

The investigation will therefore seek to determine the total road mileage in each county and incorporated community, the mileage improved with each of the several distinctive types of surfacing, the mileage under systematic maintenance, as well as to what extent the road mileage has been classified, and the mileage embraced in such classified systems.

In order that we may know something as to whether the cost of our roads is distributed in accordance with the benefits derived, the investigation will include a survey of the various sources from which the funds are derived for construction of roads, of bridges, and also for maintenance, together with the amount from each source.

Data will also be collected relative to the total investment in road machinery and equipment and the expenditures for its repair and maintenance. At present not even approximate information is available as to the amount invested by the States, counties, cities, towns, and other communities in road building and maintenance, plant, machinery, and equipment, nor as to how much is annually expended for its maintenance and repair.

The Bureau believes that, with the total annual road and street expenditures rapidly approaching the billion dollar mark, it is time that the Nation made a careful survey of the entire field of public-highway activities in order that it may have at least as much accurate information in regard to the essential features of our highway work as a private organization would hold absolutely indispensable in the interest of common sense, efficiency, and economy. The present plans provide not only for securing these data for this year, but look forward to keeping this information up to date. An extra form will be left in the hands of each road official for recording and reporting the work and expenditures, etc., for next year.

METHOD OF CONDUCTING THE SURVEY.

The Bureau of Public Roads has 13 Federal district offices which exercise control over Federal-aid projects throughout the Nation. It is proposed to make these offices the centers for gathering the data from the States comprising each district. For example, the

data for Wisconsin, Minnesota, North and South Dakota will be assembled through the Federal district office located at St. Paul. In this manner the Bureau will be in direct touch with the progress of the work and will be better able to direct it at close range.

In a few States the State highway department files contain nearly all of the rural-road data desired, and it is hoped that in time all State highway departments will be in similar close touch with the road work within their respective States. In many States, however, it will be necessary to go to the counties, towns, townships, and even special road districts for the data.

COOPERATION OF STATE AND COUNTY OFFICIALS ESSENTIAL.

To make this survey a success the Bureau feels that the cooperation of every unit of government doing road work in the Nation is necessary and essential, and therefore requests the earnest assistance and cooperation of not only all road officials, but also of all associations, organizations, or individuals that may have any information or data as to these particular lines of local highway activities.

It is apparent that no single unit of government doing road work should be omitted in gathering these

data. The Federal agents recognize that in some of the smaller units there is no centralized control and there are no complete records. Here the local motorists or others can give material assistance in checking up by speedometer readings the total road mileage within the unit as well as the mileages of the various types. Future legislation will no doubt be based upon percentages of road mileage. It is therefore essential that each unit have its total, as well as its improved, road mileage carefully recorded in this survey.

The Federal agents also point out that if future records are kept in accordance with the forms adopted for this survey, all units of government will have adopted a uniform system for recording highway expenditures. Each succeeding year it will then be possible to gather the data of expenditures with ease and with some uniformity for comparative purposes. One extra form will be left with each highway official for making a return for 1922.

Samples of the forms for reporting the data and instructions for making returns both for rural and urban communities are shown in the succeeding pages. The results of the survey will be published when the compilation is completed.

URBAN HIGHWAY MILEAGES, REVENUES, AND EXPENDITURES.

DIRECTIONS FOR MAKING RETURNS.

Purpose: The purpose of this survey is to ascertain the total mileage of urban streets, roads, sidewalks, and alleys; the character and extent of their improvement, repair, and maintenance; and the source and the amount of all funds devoted to these purposes.

Your hearty cooperation in this undertaking is earnestly desired as the survey will not be complete if the report for your municipality is fragmentary or missing.

General: Include in this report all the present existing yardage or mileage of streets, roads, bridges, sidewalks, and alleys; the work done on these during the past fiscal year, together with the amount of funds raised or received and the expenditures and indebtedness incurred for such purposes by or within the limits of your municipality. Report all mileages to nearest tenth, areas to nearest square yard, and funds and expenditures to cents.

Page 1: On page 1 report all highways within the corporate limits, including those under the jurisdiction of any special board, park commission, or other body. This applies also to work done during the past fiscal year.

Page 2: On page 2 report under the proper headings all funds or revenues received or made available for any or all of the various highway activities. Where the funds are not segregated but may be variously applied as needed to two or more purposes, as, for example, to streets, roads, and bridges, simply place a check mark in each column to which the fund may be applied and enter the total amount in the column for "totals." Do not report as a "Balance on hand at beginning of year," but as "Revenues" from the proper source the sale of bonds, appropriations, allotments, etc., intended to cover more than one year which though sold or received prior to the year in question were only partly expended. For example, street bonds

to the amount of \$2,000,000 were sold the year previous but only \$500,000 were actually expended, leaving \$1,500,000 for the year in question. Do not enter this as a "Balance on hand" but under "Funds received from sale of securities."

Page 3: On page 3 enter all expenditures or disbursements for any of the various highway activities. Segregate these expenditures so far as possible under each of the several headings. Where segregation is impossible enter the particular amount in the total column and attach a sheet stating fully the items involved.

Make sure that pages 2 and 3 balance. If they do not balance explain fully the discrepancies involved.

Page 4: In reporting highway bonds on page 4, give in addition to those authorized and those issued last fiscal year also the totals authorized and issued since 1914, the grand total of such bonds outstanding, and the sinking fund accumulations for payment of these bonds. These data should be the totals for all such bonds for the entire area within the incorporated limits.

Under question 5, page 4, report the general highway and other related data as applied to the entire municipality.

Two copies of the form are sent you herewith. You are requested to fill out one for the last complete fiscal year and return this in the accompanying addressed envelope. Kindly retain the other copy until the close of the present fiscal year and then fill out and return to the Bureau of Public Roads, Washington, D. C. In this way you will not only have a complete record of your own work but also enable the Government to form an intelligent conception of the extent and condition of our public highways and the rate at which their improvement is progressing.

URBAN HIGHWAY MILAGES AND FUNDS WITHIN LIMITS OF INCORPORATED VILLAGES AND CITIES.

Give all data for the last year and for all streets, alleys, roads and bridges within incorporated limits.

State of _____, County of _____, Town, village, or city of _____

Year ending _____

I. STREETS, ROADS, AND ALLEYS.

[NOTE.—Include under roads all drives and ways from which heavy traffic is excluded.]

A—Type of improvement.	Total existing at end of last year.			Work done during last year.					
				Construction.			Reconstruction and repairs.		
	Streets.	Alleys.	Roads.	Streets.	Alleys.	Roads.	Streets.	Alleys.	Roads.
	Sq. yds.	Sq. yds.	Miles.	Sq. yds.	Sq. yds.	Miles.	Sq. yds.	Sq. yds.	Miles.
1. Unsurfaced (give length in miles)									
2. Sand-clay									
3. Gravel, chert, shale, etc.									
4. Waterbound macadam									
5. Surface-treated macadam									
6. Bituminous macadam									
7. Bituminous concrete (mixed)									
8. Sheet asphalt									
9. Concrete (Portland cement)									
10. Brick block									
11. Wood block									
12. Stone block									
13.									
14.									
15.									
Total									
B—Bridges on above highways.									
Wood structures.	Total number								
	Total length in linear feet								
Steel structures.	Total number								
	Total length in linear feet								
Concrete structures.	Total number								
	Total length in linear feet								

C. What is average width of surfacing on streets _____ feet; Alleys, _____ feet; roads, _____ feet.

D. What mileage of State highway system, if any, is within corporation limits, _____ miles.

E. What mileage of county highway system, if any, is within corporation limits, _____ miles.

F. What mileage is so located that corporation limits forms center line of road, _____ miles.

G. What is average width of sidewalk laid, _____ feet. Total square yards laid last year, _____ Total cost, \$ _____ Total square yards in existence at end of last year _____

Remarks: _____

II. SOURCE AND AMOUNT OF HIGHWAY REVENUES.

[PAGE 2.]

Report all moneys received or collected to be used for road, street, alley, sidewalk, and bridge construction; repair, maintenance, purchase or rental of equipment; for street cleaning; for administration, engineering, and labor; for interest or principal on highway bonds, notes, etc.; and all other highway purposes for last year.

A—Source of revenues.	Amounts in dollars and cents.					Total.
	Streets.	Alleys.	Roads.	Bridges.	Sidewalks.	
1. Receipts from sale of highway securities: (See note 1).....						
Total receipts from securities.....						
2. Receipts from direct taxes: (See note 2).....						
Total receipts from taxes.....						
3. Receipts from assessment against abutting property: (See note 3).....						
Total receipts from assessments.....						
4. Receipts from appropriations, allotments, or transfers:						
Total receipts from appropriations.....						
5. Receipts, miscellaneous sources: (Give source from which received and purpose for which used:						
Total miscellaneous receipts.....						
6. Total receipts for highway purposes.....						
7. Balance on hand at beginning of last year.....						
8. Total cash funds available for highways last year.....						
B—Noncash assets.					Amounts.	
9. Rental value of equipment owned by municipality:						
(a) Construction.....						
(b) Repair and maintenance.....						
(c) Street cleaning.....						
(d)						
10. Donations and labor:						
(a) Convict labor, man-days worked,; value,						
(b) Statute labor, man-days worked,; value,						
(c) Donations of labor, materials, land, etc.,; value,						
(d)						

NOTE 1.—Example: City street bonds for resurfacing, \$300,000; assessment bonds for new street construction, \$250,000.
 NOTE 2.—Example: City tax \$0.001 for general highway maintenance, \$141,200; ward bridge tax, \$0.002, \$87,450.
 NOTE 3.—Example: Two-thirds of cost assessed on basis of foot frontage, \$38,276.

III. HIGHWAY DISBURSEMENTS.

Report all expenditures for highways, including construction, repair, maintenance, street cleaning, administration, engineering, etc. Report also any transfers from funds reported on page 2 to other funds not devoted to highway purposes or to other government units.

A—Classification of expenditures.	Amounts in dollars and cents.					Total.
	Streets.	Alleys.	Roads.	Bridges.	Sidewalks.	
1. Highway funds transferred (give fund to which transferred and use to which devoted)						
Total transfers						
2. Direct expenditures for construction (exclusive of all items under 6)						
a—New construction						
b—Reconstruction						
Total construction						
3. Expenditures for maintenance and repair (exclusive of all items under 6)						
Total maintenance and repair						
4. Expenditures, cooperative work with State, county, etc. (exclusive of items under 6)						
a—Construction						
b—Maintenance and repair						
Total cooperative work						
5. Expenditures for street cleaning, traffic control, lighting, etc.						
Total cleaning, control, and lighting						
6. Expenditures for overhead, miscellaneous, etc.:				Construction.	Maintenance and repair.	Street cleaning.
a—Administration						
b—Engineering						
c—Purchase of machinery and equipment						
d—Rental and repair of machinery and equipment						
e—Miscellaneous						
Total overhead, miscellaneous, etc.						
7. Grand total highway expenditure last year						
8. Balance on hand at beginning of last year						
9. Total cash funds available for highways last year						
B—Unfunded or floating debt.						
10. Unfunded or floating highway debt at beginning of last year						
11. Unfunded or floating highway debt at end of last year						

IV. SUMMARY OF HIGHWAY BONDS.

[Report all bonds the proceeds of which were or will be expended for streets, roads, alleys or bridges.]

Bonds by—	Proceeds devoted to—	Bonds authorized or sold last year.					Grand total.		Grand total all highway bonds outstanding at end of last year.	Total accumulation in sinking fund for paying highway bonds.
		Amount authorized.	Amount sold.	Rate %.	Term (years).	Serial or sinking fund.	Authorized since 1914.	Sold since 1914.		
Municipality as a whole.	Streets									
	Roads									
	Bridges									
	Alleys									
Wards or other subdivisions.	Streets									
	Roads									
	Bridges									
	Alleys									
Improvement or assessment districts.	Streets									
	Roads									
	Bridges									
	Alleys									
Total										

V. GENERAL HIGHWAY DATA.

Total assessed valuation of municipality..... What per cent of real value is assessed valuation..... Total outstanding indebtedness less sinking fund assets of municipality at end of last fiscal year..... What per cent is paid from general funds for new construction of streets,; roads,; bridges,; alleys, For reconstruction of streets,; roads,; bridges,; alleys, What per cent of cost is assessed against abutting property for new construction of streets,; roads,; alleys, For reconstruction of streets,; roads,; alleys, How is the cost of street or road intersections paid How is the cost of bridges paid On streets having car tracks, what part is borne by company for new construction,; reconstruction,; repair, By whom is the surfacing between the tracks done,..... Mileage of streets having single car track,; two car tracks, Name department or organization in charge of new construction Reconstruction, Maintenance and repair, Street cleaning,..... Average number employed by municipality last year in above lines of road work in following capacities: Administrative,; engineering and technical,; clerical and accounts,; skilled labor,; unskilled labor, Salary paid chief administrative official,; chief engineering official, What part of construction work is done by municipality with its own forces—sq. yds.,; \$..... What part of reconstruction work is done by municipality with its own forces—sq. yds.,; \$..... Inventory value of equipment owned by municipality for: Construction, \$.....; maintenance,; street cleaning, What has been found to be average life in years and average annual maintenance cost per sq. yd. during life of pavement in your city for the following types: Stone block, ... yrs. ... cts.; wood block, ... yrs. ... cts.; brick block, ... yrs. ... cts.; sheet asphalt, ... yrs. ... cts.; cement concrete, ... yrs. ... cts.; bituminous concrete, ... yrs. ... cts.; bituminous macadam, ... yrs. ... cts.; macadam, surface treated, ... yrs. ... cts.; macadam, plain, ... yrs. ... cts. Who replaces pavement openings What is the time limit on new pavements before openings are permitted

This information was furnished by (Title)

(Address)

RURAL HIGHWAY MILEAGES, REVENUES, AND EXPENDITURES.

DIRECTIONS FOR MAKING RETURNS.

Purpose: The purpose of this survey is to ascertain the total mileage of rural roads; the character and extent of their improvement; the expenditures incident to their management, improvement, repair, and maintenance; and the source and amount of all funds devoted thereto in any way whatever.

Kindly fill in this form at once, as this survey will not be complete if your report is fragmentary or missing.

Page 1: Report all mileages to nearest tenth, area to nearest yard, and funds and expenditures to cents. On page 1 report all mileage of the class called for in the bracket. For example, if the bracket calls for "All rural roads" in "your county" give under columns headed "Total in existence at end of last year," the mileage of all roads in your county except streets, alleys, etc., within incorporated cities, villages, etc. List them opposite the proper types. Do not omit the unimproved roads; for example, "Unimproved," 27.3 miles; "Earth roads graded and drained," 103.2 miles; "Surfaced with gravel, etc.," 211.1 miles; "Portland cement concrete," 9.6 miles; "Total," 341.2 miles, which is the total of all rural roads in the county. In the next column enter the square yards of surfacing for each of these types, as "gravel," 1,857,680 sq. yds.; "concrete," 96,540 sq. yds.; "total," 1,954,220 sq. yds., which is then the total yardage of rural surfaced roads in your county.

Under 5 state how much of the above total mileage is located on each of the several systems, as "State system," 66.3 miles; 610,280 sq. yds.; "County system," 180.7 miles; and "Township roads," 94.2 miles.

Next, under heading "Total built during last year" give in the same manner, by types, the miles and yardage of *all the construction work including reconstruction done last year within the county for the class of roads shown in the bracket* and also under 6 give how much of this mileage was located on each system. As, for example, column 3, headed "Total built during last year," "Earth roads graded and drained," 21.4 miles; "Gravel," 16.8 miles, 151,600 sq. yds.; "Concrete," 1 mile, 10,560 sq. yds. Then, under 6, on "State system," 15 miles 150,000 sq. yds.; on "County system," 23.2 miles 12,160 sq. yds.; and on township roads, 23.2 miles.

Proceed in the same manner with column headed "Total maintained last year" and record also under 7 how much of this mileage is located respectively on "State systems," "County systems," and any other systems.

Special returns: If only some particular class or system of roads is called for on page 1 under the bracket, as, for example, "Township roads," the procedure will be exactly similar except that the entries for mileage, types, construction, maintenance, etc., will be *made exclusively for township roads and only township roads within the county*, or whatever other unit the report calls for. In case of a district, only facts for the district should be included for the kind of roads shown in the bracket.

Page 2: Report all cash revenues received or collected during the last fiscal year for road and bridge construction and maintenance, administration, engineering, purchase or rental of road machinery or equipment, the payment of interest of principal of road or bridge bonds, notes, warrants, etc., and all other highway purposes.

So far as the records will permit, these funds must be so entered as to show the sources from which they were received, as follows: (1) From the sale of bonds or other securities, (2) from taxes or assessments, (3) from transfers from other funds, (4) from allotments or appropriations, and (5) from any other source. The sum of these several sources plus the balance on hand at the beginning of the fiscal year, entered under 7, will, of course, be the total cash revenue available during the year.

Do not report as a *balance*, but as *revenue* from the proper source, the sale of bonds, appropriations, allotments, etc., intended to cover more than one year, which though sold or received prior to the year in question were only partly expended. For example, road bonds to the amount of \$2,000,000 were sold the year previous, but only

\$500,000 were actually expended, leaving \$1,500,000 for the year in question. Do not enter this as a "Balance on hand," but under "Funds received from sale of securities."

In all cases where a county is reporting, unless otherwise requested in an attached letter, the *revenues* on page 2 must contain *all such revenues within the county*, including all township and road districts, or any other divisions doing road or bridge work. Thus, for example, under 1, "Funds received from sale of securities," there may be county bonds—roads, \$1,000,000; bridges, \$50,000; district and township bonds—roads, \$75,000; bridges, \$111,000; and under "Taxes"—county road and bridge tax, 3 mills, \$244,365.24; township road taxes, average 2 mills, \$105,762.11.

Where it is not possible to segregate the amounts as to whether they are for road or bridge purposes, or where they may be used for either or both, place a check mark in each column "Roads," "Bridges," and write total amount in column for "totals."

Under "B—Noncash assets," if report is for county, include all lesser units, such as townships, districts, etc., the same as for the cash revenues above, so that the return will be a correct total summary for the entire county, exclusive only of incorporated villages and cities.

Page 3: Report all highway disbursements, such as expenditures for road and bridge construction and maintenance, purchase or rental of equipment, administration, engineering, payments of interest or principal of road or bridge bonds, warrants, etc., or the transfer of any moneys reported as road revenues on page 2 to any other funds or other funds or other units of government.

If the county is the unit reporting, this page should include all disbursements from county highway funds, plus all such disbursements from township and district funds. State funds must not be included in reports for counties, towns, or districts, except where such funds were actually received into the county, town, township, or district treasury. In such cases these funds must also be shown as receipts on page 2.

Segregate the expenditures so far as possible; first, into work done in cooperation with some other unit, whether that be the State or a township, town, district, etc.; second, into work done without cooperation, whether by the county, township, towns, or districts; third, segregate these into expenditures for construction and maintenance of roads and bridges, respectively; and fourth, enter the amount of each under the respective class of road on which the work was done, such as State roads, county roads, township roads, or whatever the particular designation may be. Where any estimates are involved, place a capital letter (E) after the figure, as bridge repairs, \$3,250 (E).

In every case where the report is for a county, or lower unit, and the bracket on page 1 calls for "all rural roads," page 3 must give all expenditures or disbursements for rural road purposes made by this unit, plus the expenditures if any, by all other units contained within the area of the unit reporting.

See that pages 2 and 3 balance properly, and if not attach a separate sheet explaining fully all discrepancies.

Pages 4 and 5: These pages are self-explanatory. Where a county is reporting, the requested summarized total of bond and administrative data for townships and districts must be included, but all State data omitted.

General: Two copies of the form are sent you herewith. You are requested to fill out one for the last complete fiscal year and return it in the accompanying addressed envelope. Kindly retain the other copy until the close of the present fiscal year, and then fill out and return to the Bureau of Public Roads, Washington, D. C. In this way you will not only have a complete record of your own road work, but also enable the Government to form an intelligent conception of the extent and condition of our public roads year by year.

RURAL HIGHWAY MILEAGES AND FUNDS OUTSIDE OF INCORPORATED VILLAGES AND CITIES.

Give all data for the last year, and only for the unit of Government named below:

State of _____, county of _____, district or township of _____

Data refers exclusively to _____
For year ending _____

All rural roads _____
State roads _____
County roads _____
Township roads _____
District roads _____

I. HIGHWAY MILEAGE.

[NOTE.—Report only roads of the class not crossed out in the bracket above. Give only one-half of mileage for roads located on the boundary of the unit reporting. Give mileage to nearest one-tenth mile.]

A—Type of road improvement.	Total in existence at end of last year.		Total built during last year.		Total maintained during last year.	
	Miles.	Sq. yards.	Miles.	Sq. yards.	Miles.	Sq. yards.
1.1 unimproved roads						
1.2 earth roads, graded and drained						
1.3 sand-clay roads						
1.4 gravel, chert, shale roads, etc						
1.5 water-bound macadam roads						
1.6 surface-treated macadam roads						
1.7 bituminous macadam (penetration)						
1.8 surfaced with sheet asphalt						
1.9 surfaced with bituminous concrete ¹						
2 surfaced with concrete (Portland cement)						
2.1 surfaced with brick						
2.2 surfaced with wood block						
2.3 surfaced with stone block						
2.4 surfaced with (give kind)						
3 Total						

B—Bridges on above roads.	Total number in existence at end of last year.			Number built during last year.			Linear feet of bridges built last year.			
	Type.....	Wood.	Steel.	Concrete.	Wood.	Steel.	Concrete.	Wood.	Steel.	Concrete.
4. Bridge data										

C—Designated highway systems.	State systems.		County systems.			
	Miles.	Sq. yards.	Miles.	Sq. yards.	Miles.	Sq. yards.
5. Of existing total listed under (3) give amount on						
6. Of total miles built listed under (3) give amount on						
7. Of total miles maintained under (3) give amount on						

Remarks: _____

Includes Warrenite, Topeka, etc.

II. SOURCE AND AMOUNT OF HIGHWAY REVENUES.

[PAGE 2.]

Report below all moneys received or collected for road and bridge construction and maintenance; purchase or rental of equipment; administration or engineering; interest or principal of bonds, notes, etc; and all other highway purposes for last year for unit or units given on page 1.

A—Source of cash revenues.	Amounts in dollars and cents.		Total.
	Roads.	Bridges.	
1. Funds received from sale of securities: (See note 2)			
Total receipts from securities			
2. Funds raised by taxes; give purpose, unit, rate, and amount: (See note 3)			
Total receipts from taxes			
3. Funds received by transfers; give source from which received, and purpose for which used:			
Total receipts from transfers			
4. Funds from allotments or appropriations; give source and purpose:			
Total receipts from allotments or appropriations			
5. Miscellaneous cash receipts; give purpose of fund: (a) Donations			
(b) Tolls			
(c) Fines			
(d) Rental of machinery or equipment			
(e) Motor vehicle fees [if not included under (3) or (4)]			
(f) Gasoline tax [if not included under (3) or (4)]			
(g)			
Total miscellaneous receipts			
6. Total receipts to highway funds			
7. Balance on hand at beginning of year			
8. Total cash funds available for highway purposes			
B—Noncash assets.		Amounts.	Value.
9. Convict labor; total man-days worked			
10. Statute labor; total man-days worked,			
; team-days,			
11. Donations of material, land, or equipment			
12. Rental value of construction equipment owned			
13. Rental value of maintenance equipment owned			
(Reduce these to estimated cash value.)			

NOTE 2.—Give name of unit; for example, county road bonds, for construction, \$300,000; or township bonds for bridge repair, \$250,000.

NOTE 3.—Where smaller units have separate and varying levies, group them and give the average rate and total yield; for example, township road taxes—average rate, 1 per cent; total yield, \$300,000.

III. HIGHWAY DISBURSEMENTS.

Report all expenditures, payments, and transfers of moneys reported as highway revenue on page 2, including road and bridge construction and maintenance purchase or rental of equipment; administration or engineering; interest or principal of bonds, notes, warrants, etc.; and all other highway purposes of last year.

A—Character of cash expenditures.	Amounts in dollars and cents.			Total.
1. Funds transferred to other Government units; give purpose and amounts: To State, for County for Township for district, for Total funds transferred				
2. Funds expended for cooperative work exclusive of overhead: A—Road construction on B—Bridge construction on C—Road maintenance D—Bridge maintenance Total cooperative expenditures	State roads.	County roads.	roads.	
3. Funds expended under exclusive control, exclusive of overhead: A—Road construction B—Bridge construction C—Road maintenance D—Bridge maintenance Total expenditures exclusively controlled				
4. Funds expended for overhead (not included above): A—For administration B—For engineering Total expenditure for overhead	Construction.		Maintenance.	
5. Miscellaneous cash expenditures (not included above): A—Payment of interest on highway bonds, warrants, notes, etc B—Payments to principal or sinking fund for highway bonds, notes C—Payments for policing or traffic control D—Payments for rental of machinery or equipment E—Purchase of machinery or equipment F—Payments for repairs of machinery or equipment Total miscellaneous expenditures			Amounts.	
6. Total expenditures of highway funds				
7. Unexpended cash balance on hand at end of last year				
8. Total cash funds available for highway purposes				
B—Noncontrolled cooperative work:				
9. Funds expended by to match cooperative expenditures listed under (2) above, but not included in funds listed on page 2 as incoming revenue.				
(a) Road construction, \$			Road maintenance, \$	} Total, \$
(b) Bridge construction, \$			Bridge maintenance, \$	
C—Unfunded or floating debt:				
10. Amount of warrants, notes, vouchers, or bills unpaid at beginning of year				\$
11. Amount of warrants, notes, vouchers, or bills unpaid at end of year				\$

IV. SUMMARY OF HIGHWAY BONDS.

[Report here only bonds used for road, bridge, or other highway purposes.]

Unit.	Highway bonds authorized or sold last year.						Grand total highway bonds.		Total highway bonds outstanding at end of last year.
	Purpose.	Amount authorized.	Amount sold.	Interest rate.	Term years.	Serial or sinking fund.	Authorized since 1913.	Sold since 1913.	
State.	Roads								
	Bridges								
County.	Roads								
	Bridges								
Township.	Roads								
	Bridges								
District.	Roads								
	Bridges								
Total									

V. SUMMARY HIGHWAY ADMINISTRATION.

	Items.	State.	County.	Township or district.
(A) Taxation.	Assessed valuation for.			
	Road purposes			
	Bridge purposes			
	General purposes			
	What per cent of actual valuation is assessed valuation			
	Total present bonded indebtedness, all purposes			
(B) Organization.	Administrative board.	Number of persons constituting board		
		By whom appointed		
		Term of office, in years		
		Salary or compensation		
	Engineer.	By whom selected		
		Term of office, in years		
		Salary or compensation		
	Number of employees engaged.	For administrative purposes		
		For engineering purposes		
		Other employees except laborers		
Average number of laborers per working season.				
	Average length of working season, days.			
Districts.	Number for construction purposes			
	Number for maintenance purposes			

V. SUMMARY HIGHWAY ADMINISTRATION—Continued.

		Items.	State.	County.	Township or district.
(C) Operation.	Contract work last year.	Miles of road built by contract last year			
		Total amount paid for this mileage			
		Number of linear feet of bridges built			
		Total amount paid for these bridges			
	Day labor or force account work last year.	Miles of road built by this method			
		Total amount paid for this mileage			
		Number of linear feet of bridges			
		Total amount paid for these bridges			
	Convict labor work last year.	Miles of road built by this method			
		Total amount paid for this mileage			
		Number of linear feet of bridges			
		Total amount paid for these bridges			
Total amount paid for other convict work. Give kind					
Average number employed during season.					
Average cost of maintenance per man per day.					
Wages paid last year.	Who has charge of construction				
	Who has charge of guarding and discipline.				
	Common labor per day, average				
Equipment.	Patrolmen, per month, average for season.				
	Man, team, and wagon per day, average				
	Inventory value of, for construction				
Toll roads and bridges.	Inventory value of, for maintenance				
	Total miles toll roads				
	Total number toll bridges				
(D) General.	Miscellaneous.	(Increase) or (decrease) last year			
		Total public expenditures all purposes			

This information was submitted by _____,

(Title) _____,

(Address) _____

SEMIPERMANENT GUARD FENCE BUILT ON FEDERAL AID ROADS

By C. L. McKESSON, Senior Highway Engineer, Bureau of Public Roads.

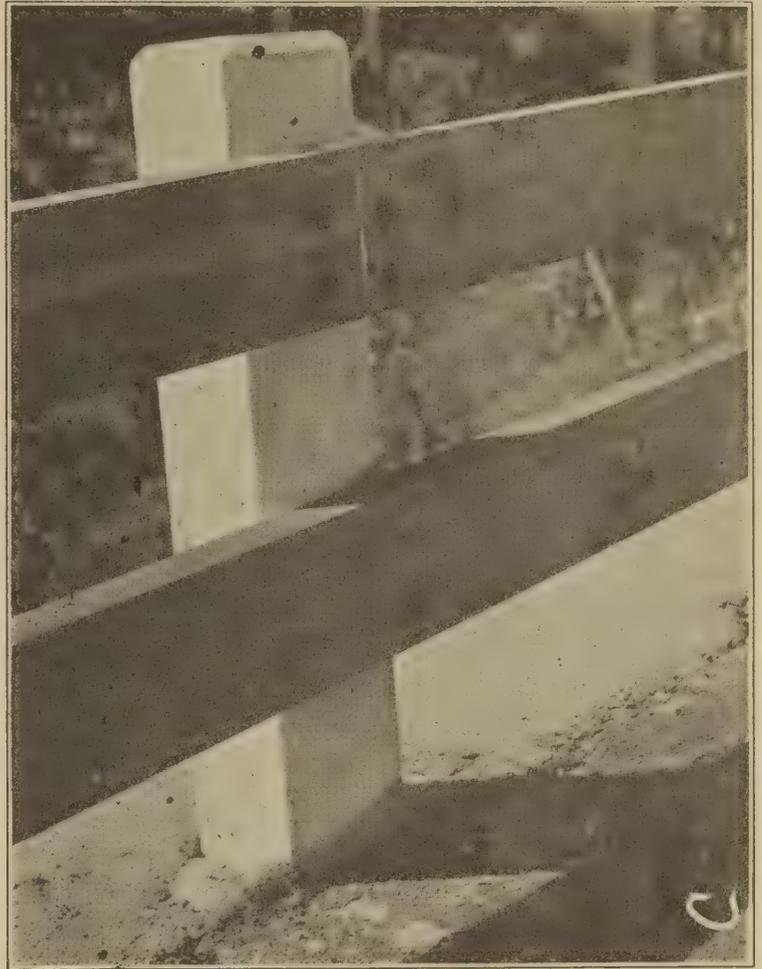
GUARD fence is an important item of construction on highways which traverse broken or mountainous country or where curvature renders such protection necessary.

The typical guard fence in use in the Pacific northwest consists of 8 by 8 inch wooden posts with two or three wooden rails, usually of 3 by 8 inch lumber. These fences, when painted white, are neat and serviceable, but, owing to the relatively short life of the wooden posts, they can be considered only as temporary structures.

In the construction of Washington Federal-aid projects Nos. 34 and 44, engineers of the Washington highway department have tried a new form of fence, in which the wooden posts are replaced by posts of concrete, making the entire structure semipermanent.

Carefully compiled cost data on about 6,600 feet of fence show that the more durable structure is little more expensive than the all-wood fence, and as the details of the construction are believed to be new a brief description may be of interest to the readers of PUBLIC ROADS.

For purposes of economy and convenient erection it was considered necessary that the concrete posts should be light enough to permit of easy handling, that some simple and satisfactory means be provided for securing the rails to them, and that some arrangement be made whereby the posts could be cast in standard lengths and still be capable of erection in holes of varying depth. These problems have been solved very satisfactorily.



THE FENCE PRESENTS A NEAT AND WORKMANLIKE APPEARANCE.

TABLE 1.—DISTRIBUTION OF COSTS.

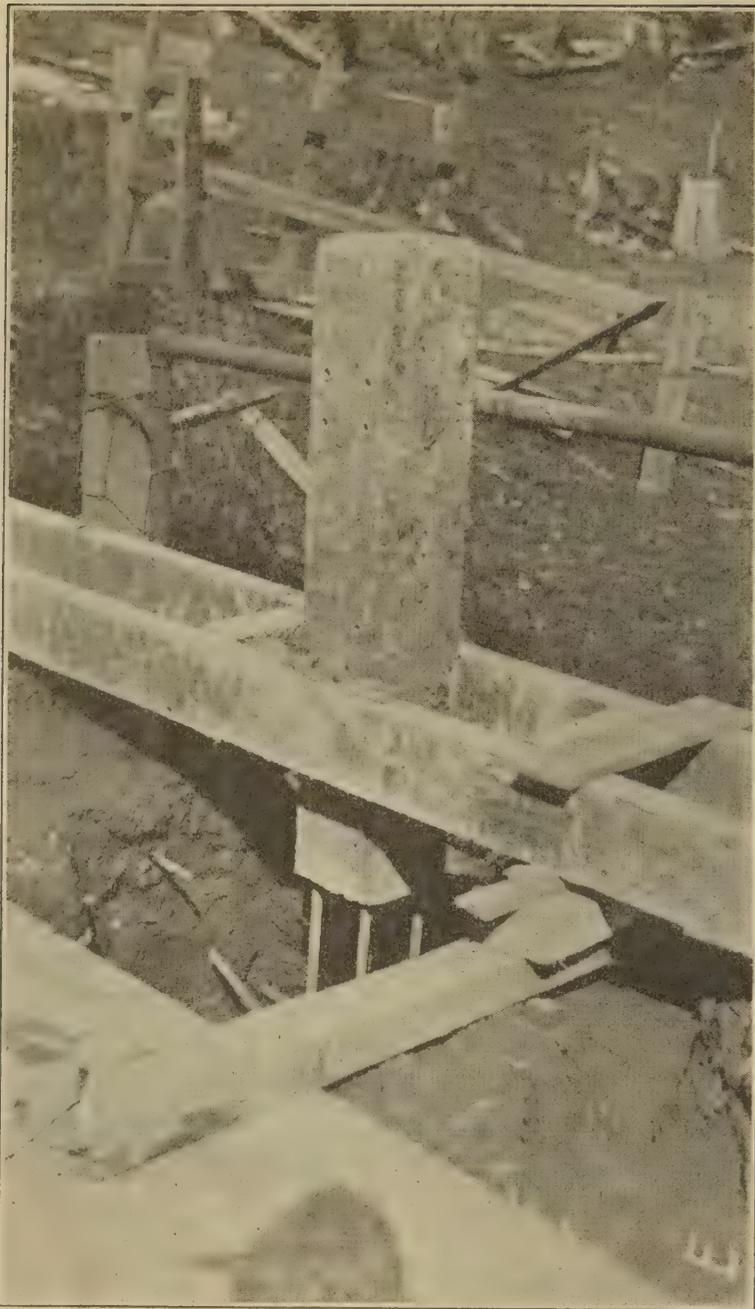
GUARD RAIL WITH CONCRETE POSTS IN CLARKE COUNTY AND KLICKITAT COUNTY, WASH.

Class of work.	Quantity represented.	Labor.	Material.	Equip-ment.	Total.	Remarks.
Casting, curing and finishing posts.....	883 posts.....	\$1,362.22	\$1,902.38	\$409.40	\$3,674.00	Includes casting, curing, stripping forms, and racking up in storage until used on grade.
	1 post.....	1.54	2.16	.46	4.16	
	1 linear foot (posts spaced 10 feet).....	.15	.22	.05	.42	
Hauling and placing posts.....	704 posts.....	\$2,589.45	\$883.52	\$30.00	\$3,502.97	Includes hauling sand, gravel, and cement for postholes; hauling posts; setting posts and mixing and placing concrete in postholes. (This item completes posts for rails.)
	1 post.....	3.68	1.26	.04	4.98	
	1 linear foot (posts spaced 10 feet).....	.37	.13	.05	.50	
3 by 8 inch rails in place (not painted)..	6,604 linear feet guard rail.....	\$618.16	\$1,112.52	\$0.50	\$1,731.18	Includes lumber, bolts, and washers, paint at joints, and labor placing. (This item completes rail except paint.)
	1 linear foot guard rail.....	.09	.17	.07	.26	
Casting, curing, and finishing posts, per linear foot.....		\$0.15	\$0.22	\$0.05	\$0.42	Summary of costs.
Hauling and placing posts, per linear foot.....		.37	.13	.05	.50	
3 by 8 inch rails in place (not painted), per linear foot.....		.09	.17	.07	.26	
Total, per linear foot.....		.61	.52	.05	1.18	

NOTE.—The above distribution of cost is only for actual labor and materials expended and consumed during construction. No compensation is allowed for the use of equipment and overhead, etc.

MATERIAL COSTS.

Sand at casting plant.....	\$1.10 per cubic yard.	Reinforcing rods.....	\$0.05½ per pound.
Gravel at casting plant.....	1.35 per cubic yard.	Bolts.....	.09 each.
Cement in car on job.....	2.90 per barrel.	Basic wage.....	5.00 per 8-hour day.
Lumber at mill.....	23.00 per M.	Average haul from casting plant.....	2½ miles.
Pipes.....	.06½ each.		



METHOD OF SUPPORTING THE POSTS IN SETTING.

THE DESIGN OF THE POSTS.

The concrete posts were made in one size only—8 inches square and 42 inches long. They were made of a 1:2:3 mix, using a gravel coarse aggregate of a maximum size of $2\frac{1}{2}$ inches and reinforced with four $\frac{1}{2}$ -inch square deformed bars placed in the corners 2 inches from the surface. The bars were allowed to project 26 inches below the lower end of the posts, and this was an important feature of the design, as will be explained later. To provide for attaching the rails, eight $\frac{1}{2}$ -inch pipes 8 inches long were embedded at the proper points in the concrete; and to prevent undue chipping of the edges the four corners of the posts and the top edges were finished with a 1-inch bevel. The posts were cast in gang molds at a central plant and hauled to the work after being properly cured.

In setting the posts, holes were dug as for wooden posts. In earth or other material which could readily be excavated the holes were dug 3 feet deep and approximately 1 foot square. Where solid rock was encountered or where, as in one case, the fence was to be constructed on top of a masonry wall, larger and shallower excavations were made.

The posts were supported over the postholes as shown in one of the illustrations, the reinforcing rods extending downward. The postholes were then filled with 1:3:5 concrete, which formed the base of the post. Where the postholes could not be excavated to full depth, the rods were bent outward and the wider and shallower bases thus provided acted as pedestals, which, if desired, could be carried under the edge of the pavement. Grade and alignment on these projects were obtained from the edge of the concrete pavement, but grade stakes would be necessary where no pavement had been constructed.

After the bases had been poured, the exposed portions of the posts were finished with cement grout and rubbed with a carborundum brick, and the resulting construction presented a neat and workmanlike appearance, as shown by the illustration on page 15.

Where the curvature was greater than 9° , the posts were spaced 8 feet apart on centers. In other places the posts were set 10 feet apart and the rails were made 20 feet long. The rails were long enough, therefore, to span two of the spaces between posts and they were so attached that the joints in top and bottom rails occurred on alternate posts, thus requiring the use of only six of the $\frac{1}{2}$ -inch bolts to each post. Abutting ends of the rails were thoroughly coated with white lead and oil at the time of erection, and normally the rails should be painted immediately. They were not painted on the two projects on which the fence has been built because of rainy weather, and they will not be painted until the summer weather dries them thoroughly.

The tops of the posts were set 39 inches from the ground, the lower edge of the bottom rail 10 inches above the ground, and a space of 8 inches was left between the rails. The height of the bottom rail should be such that an automobile wheel hub of average height will strike it in the center.

THE COST OF THE FENCE.

The work on the two Federal-aid projects was done on a force account basis because it was the first construction of its kind and was considered as more or less in the nature of an experiment. Accurate cost data are therefore available and are recorded in Table 1. Allowing a 10 per cent profit in addition to the net cost as shown, brings the cost up to \$1.30 per linear foot. It is estimated that painting will cost 10 cents

(Continued on page 21.)

DIRECTION AND WARNING SIGNS ARE STANDARDIZED IN ENGLAND.

IN a letter sent by the English ministry of transport to the local government bodies early this year the ministry recommended a scheme of standard direction posts and warning signs to be adopted throughout the country. The adoption of the standards defined is not made compulsory, and, indeed, the minister particularly states that he does not advocate any wholesale replacement of serviceable signs now in use, but the local officials are strongly urged to conform to the new standards in erecting future signs.

The standard signs and post adopted are reproduced in the accompanying illustrations and the recommendations which accompanied the minister's letter are given as follows:

RECOMMENDATIONS FOR THE STANDARDIZATION OF ROAD DIRECTION POSTS AND WARNING SIGNS.

The character of the road information which it is desired to present to the traveling public may be conveniently grouped under the following heads:

- I. Road direction posts.
- II. Warning signs and notices.
- III. Village and place name signs.

I. ROAD DIRECTION POSTS.

(1) The careful selection of the most suitable position for the direction post is of great importance, so as to secure the maximum visibility on all the roads of approach. In certain cases it may be advisable to resite existing posts to secure a more dominant position.

(2) It is generally undesirable to mask the lower portion of the post in hedges or shrubs. The full length of the post should be visible wherever possible.

(3) The projection of the direction arms over the roadway should be avoided.

(4) The direction arms should be set at such angles on the head of the post as to insure that each arm shall lie along the immediate general direction of the road it is indicating.

(5) In all cases the lower arms should indicate the more important road, and only the arms indicating the same road should be set in the same horizontal plane.

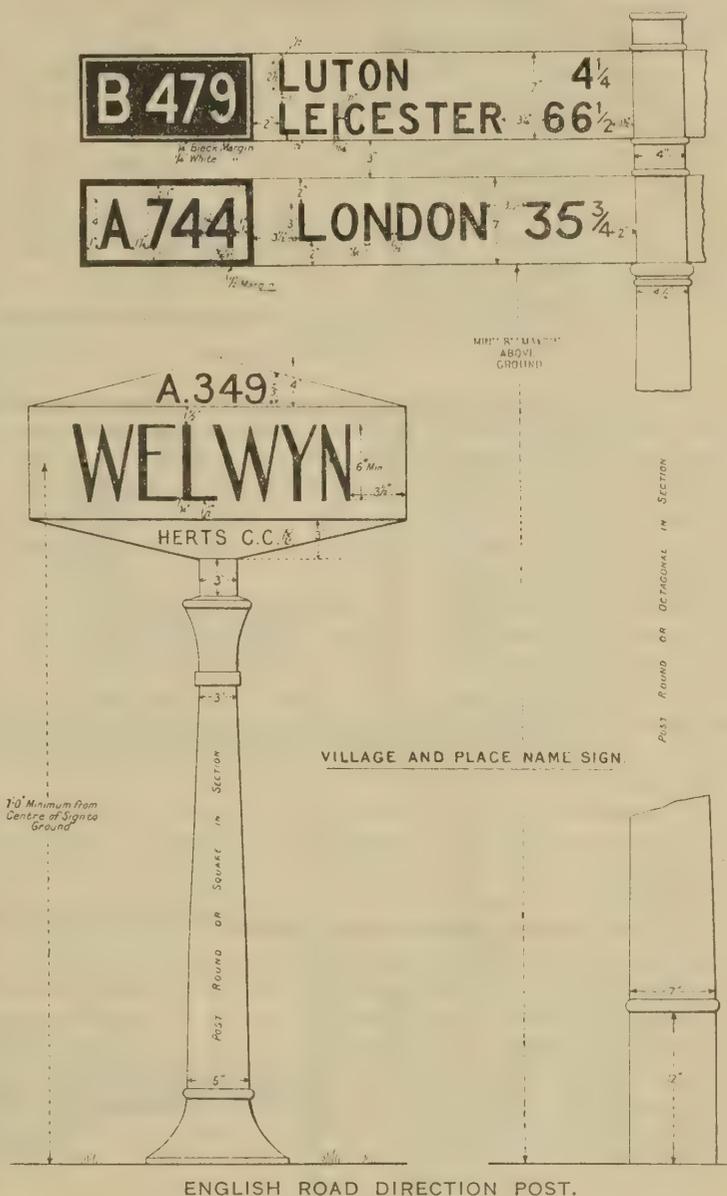
(6) The top and bottom diameters or widths of the supporting posts, as figured upon the accompanying diagrams, are optional, but for new posts it is suggested that these dimensions should be taken as a guide.

(7) Where the text and size of lettering upon the arms of an existing post are otherwise suitable, the route number may be conveniently added and secured to the end of the direction arm by means of a sleeve connector and set screws.

(8) The length of arm for new direction posts will be mainly dependent upon the number of letters in the longest place name. Due regard should be had to the size of the route number, the spacing between words, and the proportions of the letters as figured on the diagrams.

Dimensions and details recommended for standardization.

- (a) Height of arms from ground { Minimum, 8 feet.
Maximum, 9 feet.
- (b) Length of arm, including route number
(variable) Minimum, 3 feet.



ENGLISH ROAD DIRECTION POST.

- (c) Depth of arm Minimum, 7 inches.
- (d) Separation between arms Minimum, 3 inches.
- (e) Lettering, black block letters raised $\frac{1}{8}$ inch on white ground:
 - For single line 3-inch letters.
 - For double line $2\frac{1}{2}$ -inch letters; $\frac{1}{2}$ -inch space between lines.
- (f) Post Painted plain white.
- (g) Route numbers 4-inch block figures, raised $\frac{1}{8}$ inch, in panel at end of arms.
- First-class roads—Black letter A and figures on white ground.
- Second-class roads—White letter B and figures on black ground.
- (h) Precedence of routes Lower pair of arms indicating the more important road.
- (i) An indication shall be given on the post of the highway authority responsible for its maintenance.

(j) In all but exceptional cases the arm should be lettered on both sides, the nearest village being given first, then the nearest important town, followed by the terminal town where necessary. The mileage should be given in figures only, immediately following the place to which it refers, the lowest fraction being a quarter.

(k) Wherever possible, the direction post should be placed in such position as to be visible to traffic from all converging roads for a distance of at least a hundred yards.

(l) The authority having control over the more important roads should be responsible for the provision and maintenance of the necessary direction posts at the road junctions.

(m) The distances on the direction arm should be measured from the (civic) center of the town or village indicated.

(o) The color of the supporting posts of road direction posts, and also the field of the arms, should be painted plain white. The bordering, letters, and figures should stand in relief $\frac{1}{8}$ inch above the field and be painted black.

II. WARNING SIGNS AND NOTICES.

(1) The value and position of all danger signs now existing should be most carefully reviewed in the light of the following recommendations, and all redundant or unnecessary signs withdrawn from use. It is believed that a few signs, in carefully selected positions, and intended definitely to control cases of real danger, will have a greater effect than the indiscriminate use of a large number of signs of varying shapes and colors.

(2) Importance is attached to the careful selection of the site and the placing of the post clear of bushes or other obstruction to visibility and so that the full length of the supporting post is seen. Where a choice of position exists due regard should be paid to the background for showing up the sign. For this reason the diameter or widths of the post as shown on the diagram, while optional, are recommended for use.

(3) The present signs, as recommended in the circular letter from the local government board, dated March 10, 1904, for "Speed limit" (and its notices), "Prohibition," "Caution," and "Other notices" should be retained.

(4) *The red triangular sign indicating "Caution" should in future be used to mean "Danger," and should be referred to as the "Danger" sign.*

(5) The special danger to be guarded against should be indicated by means of a clear and legible symbol, based on the international symbols as far as applicable, together with a clear and simple title in letters 2 inches high, upon a vertical plate 12 inches wide and 21 inches long to be attached to the post below the danger sign.

The list of dangers to be notified in this manner are as follows:

"School."

"Level crossing."

"Cross roads."

"Corner" and "Double corner."

"Steep hill."

(See diagrams at the end. The signs for "Corner" and "Double corner" are reversible for right or left turns respectively. The illustrations show a right-hand turn.)

The symbol should be regarded as the principal means of indicating the nature of the danger to be guarded against.

(6) Cast iron is recommended for the material of which the plates should be constructed, with letters and details in relief. Flat enameled sheet iron is not recommended owing to its liability to damage and defacement by stones.

(7) In towns and suburban areas, where street lighting arrangements permit, the illumination of road signs would be desirable as far as this can be done conveniently.

(8) At certain special danger points upon roads of the above character it may be found desirable by the highway authority to erect special illuminated signs of the glass-fronted, internally illuminated type. In these cases, the red triangle and appropriate symbol, where used, should be enlarged to a uniform size of one and one-half times the standard size.

Dimensions and details recommended for standardization.

(a) Height to the underside of the triangle from ground, 9 feet.

(b) Space between triangle and top of notice plate, 6 inches.

(c) Size of notice plate over all, 12 inches wide, 21 inches high.

Upper portion containing symbol, 15 inches in height.

Lower portion containing text of notice, 6 inches in height.

Two-inch letters with $\frac{1}{2}$ -inch separation for two lines, $\frac{1}{4}$ -inch margin all round.

Symbols to be of standard pattern only, as above, or as added to from time to time. To be raised $\frac{1}{8}$ inch and painted black on a white field.

(d) Height of lower edge of notice plate from ground, 6 feet 9 inches. No danger signs to be exhibited without symbols.

(e) All danger signs to be placed facing approaching traffic and on near side of road, and, generally speaking, should be set so as to display the full length of supporting post.

(f) They should be sited as closely as possible to a distance between 75 and 100 yards from the object of danger or commencement of the danger zone, and, if possible, so placed that on either side of its position a length of roadway and margin is clear and free from any obstruction to view, such as lamp post, telegraph pole, tramway standard, tree, etc.

(g) All posts to which signs are affixed to be painted white, and to be iron or other suitable material and firmly embedded in the ground.

(h) Where there are direction posts at crossroads and junctions in visible positions, it is recommended that "Crossroad" danger signs are not necessary. The approaches to towns or villages also should need no warning sign, as such inhabited places are a sufficient indication in themselves that special care is necessary.

(i) The color of the red triangle on the danger post should be what is known as "signal red," or "post-office red."

The color of the supporting posts of warning signs, and also the field of the plates, should be painted plain white. The bordering, letters, figures, and symbols should stand in relief $\frac{1}{8}$ inch above the field and be painted black.

III. VILLAGE AND PLACE NAME SIGNS.

(1) It is generally agreed that it would be a great convenience to the traveling public if notices were erected on the main approaches to towns and villages, giving the name of the town or village. These name plates are recommended for adoption, where necessary. The plate can also conveniently carry the route number of the road upon which it is erected and the name of the county council or county borough council.

(2) The width or diameter of the supporting post at top and bottom is optional, as is also its design, but it is recommended that these dimensions should not be substantially less than those figured upon the diagram annexed hereto. The form and proportion of the letters will, of course, determine the length of the plate. Certain place names of more than average length, e. g., two long words with a hyphen between, could be conveniently arranged in two lines.

The size of letter given in the accompanying diagram should always be regarded as a minimum.

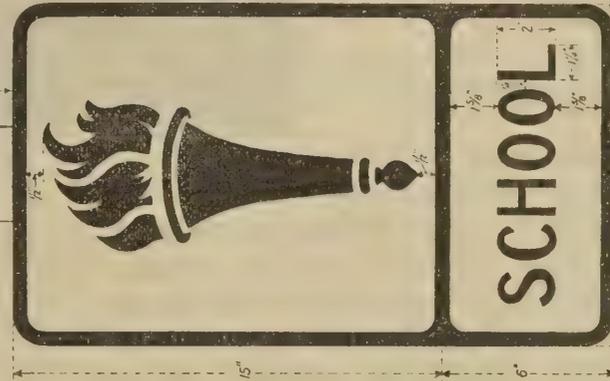
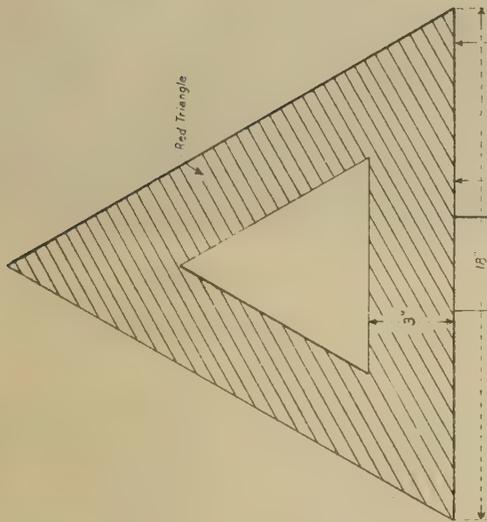
Dimensions and details recommended for standardization.

(a) Height to center of name on plate, 7 feet (minimum).

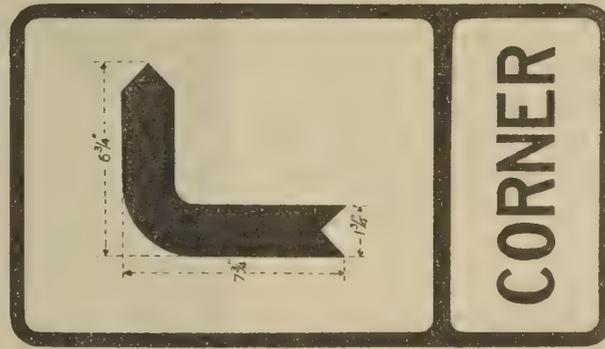
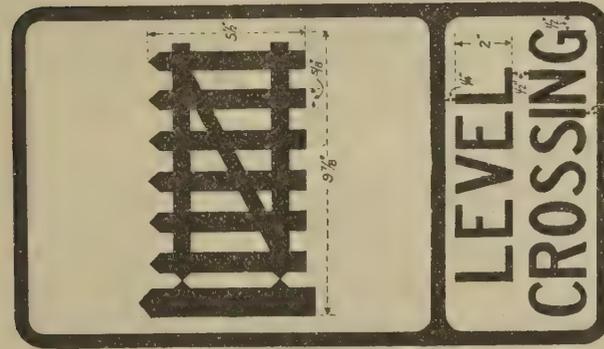
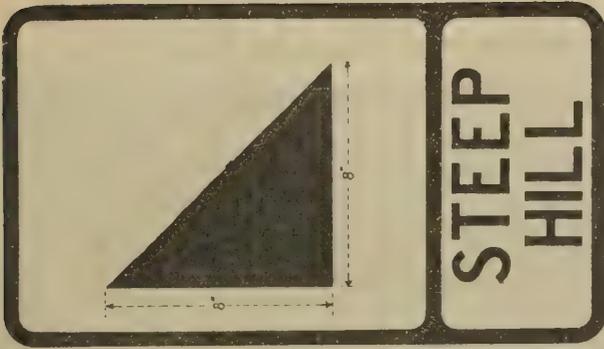
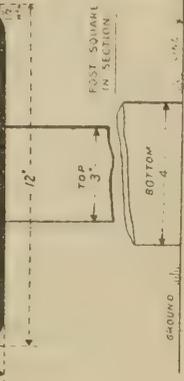
(b) Height of letter, 6 inches. To be raised, painted black on white field, down stroke to equal twice the width of up stroke, $1\frac{1}{2}$ inches to 2 inches clearance top and bottom. Route numbers to be in 3-inch letters. Council's title in $1\frac{1}{2}$ -inch letters.

(c) To be sited on near side of road facing approaching traffic and at a distance of approximately 100 yards or thereabouts from the first houses of the village or town.

(d) The color of the supporting posts, and also the field of the sign, should be painted plain white. The letters and figures should stand in relief $\frac{1}{8}$ inch above the field and be painted black. The color used to denote the name of the highway authority on the sign is optional.



9'0" Height of lower
Edge of Triangle from
Ground



MARYLAND MARKERS EXPLAIN LAWS AND PROTECT TRAVELERS.

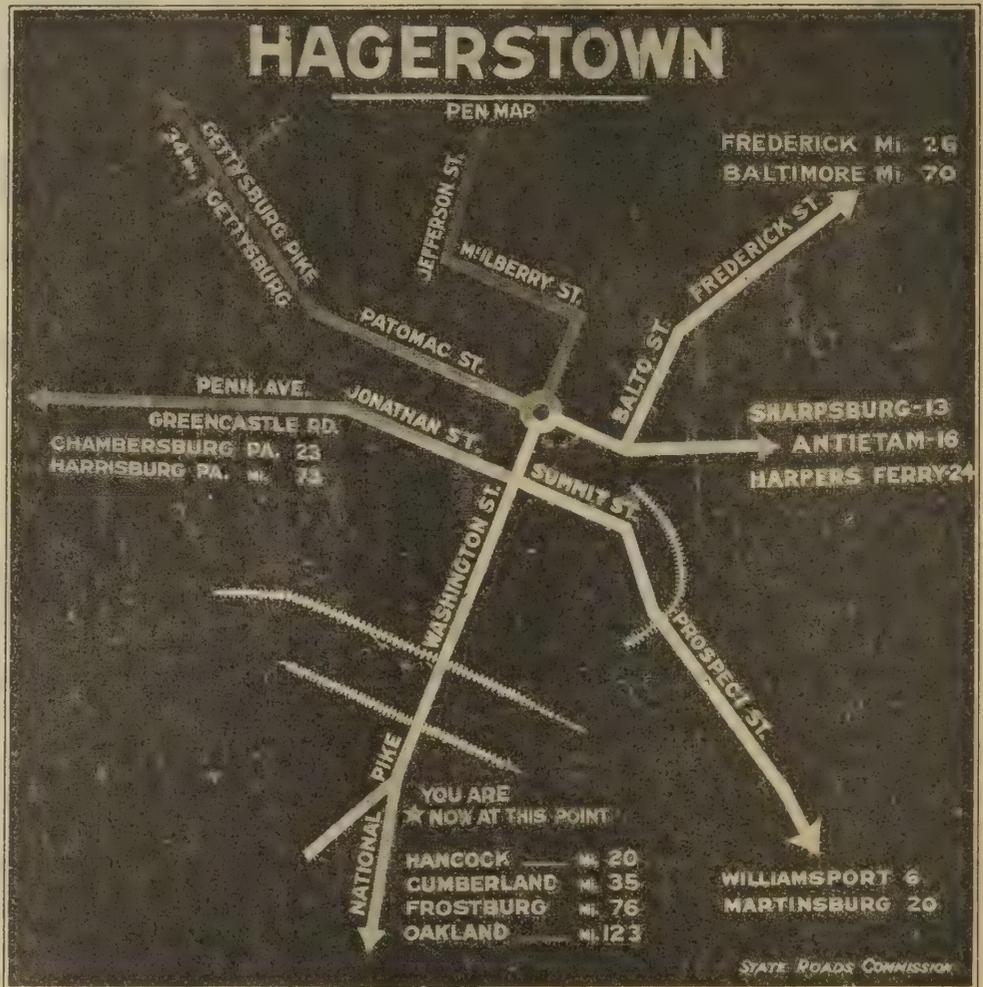
By Harry D. Williar, Jr., Assistant Chief Engineer, Maryland State Roads Commission.

IN many respects the new road markers which the Maryland State roads commission has begun to erect on the State roads will differ from any that have been erected heretofore in this country or abroad. The usual highway marker is merely a direction guide or a danger signal. The Maryland plan is to give the traveler much more complete information. Not only will the signs inform the traveler where he is, indicate the general direction to other points and give the distance to such points, but they will also give him a map to guide him on the way—a map so clear that “he who runs may read.”

Not only will the signs call attention to dangerous places but they will also tell the motorist just how to drive his car in order to avoid trouble. In addition to this service, signs erected at the principal gateways to the State will explain the Maryland traffic laws for the benefit of the stranger and thus reduce the probability of entanglements with the law which otherwise might mar the journey.

Maryland's road system is justly famous throughout the country for its uniform excellence and for the high state of repair in which it is kept. Last winter the roads commission equipped itself to battle with the snow which heretofore has impeded winter travel in some parts of the State, and hereafter the arterial highways will be kept open at all times, winter and summer. With a completed road system that touches every county seat, kept in condition and open to travel at all times, there is little more to be desired from the standpoint of the roads themselves.

Their road system built, the people of the State are now turning their attention to the protection of the roads from damage by thoughtless operators of heavy vehicles and the protection of the traveling public from reckless drivers and other dangers of the road. The roads are being protected by systematic weighing of vehicles which appear to be too heavy. Permanent scales have been installed in some of the principal roads and flying parties pick up the overloaded vehicles on other roads with loadometers. These methods have



ONE OF THE SIGNS ON THE NATIONAL PIKE.

practically put an end to road damage by heavy trucks.

The next advance came with the organization of the State police last winter. Equipped with motorcycles and operating under the State motor vehicle commissioner, a group of virile young men, especially trained for the work, is rapidly reducing the hazards which go hand in hand with speeding and reckless driving. Still the roads have not given a maximum of service because they have not heretofore been marked so that the traveler could go wherever he wanted without the aid of maps and numerous stops to acquire information or misinformation as it often turns out.

To remedy this defect in the otherwise complete service the State roads commission has settled upon the plan of marking the State highways which is now being worked out. The signs which will be used in greatest number are the direction and distance signs which will be set up along the roads between towns and at crossroads. These will have a metal face backed with wood, and, mounted on wooden posts set in con-



A TYPICAL DIRECTION SIGN.

crete, it is expected that they will give many years of service. They will be 30 inches wide by 20 inches high, and will display, in white letters about 3 inches high on a black background, the name of the road, as for example, "National Pike," the distance to and from important points, and all principal connections. Sufficient signs will be used clearly to indicate the desired points, so that travelers may feel assured that if they observe the signs they can not go wrong.

MAP SIGNS AT TOWN LIMITS.

In addition to these direction and distance signs, there will be erected at the limits of each of the large towns a 10 by 10 foot map painted on wood. This map will show the main routes through the town in white and the secondary routes in gray, the names of the streets and well-established landmarks, so that a person can decide the route he wishes to take and follow it without difficulty. The color scheme for these maps will be the same as for the direction signs—white letters on black background. They will be oriented to read in the direction of travel, so that if the signboard were laid upon the ground it would point in the right direction. On the map in red will be a star and the following wording: "You are now at this point." This star on the map will correspond identically to the location of the map on the ground.

At the top of the mountain grades in the western part of the State boards will be erected similar in size to the map boards. These will tell the motorist the number of miles down the mountain, will warn him of curves, and give him concise instructions as to how to drive down the mountain to avoid accident and personal injury or damage to the car. These signs are expected to prove of great assistance to the motorist inexperienced in mountain driving. On account of the great length of the grades, inexperienced

drivers have previously had considerable difficulty in braking their cars, and it is remarkable that there has not been a greater number of serious accidents.

In addition to the signs which have been described, another class of signs will be erected at all points where the State roads cross into the neighboring States. These will be large signs, 15 by 25 feet in size, on which will be displayed the salient features of the Maryland motor vehicle laws with reference to both pleasure vehicles and motor trucks. These will inform all visitors at the moment they reach the State line and cross into Maryland exactly how to comply with the laws of the State. Those who sincerely want to comply with the law will be guided by these signs and thereby avoid unpleasant encounters with the new State police. Those who ignore the well-meant advice will at least be deprived of the time-worn excuse of ignorance of the law.

A contract has already been let for the erection of the markers on the road from the Delaware line at the east, through Elkton, Belair, Baltimore, Frederick, Hagerstown, Cumberland, and on to the Pennsylvania line at the west. The work of marking the National Pike has begun and will be completed within 30 working days.

The contract prices for the signs are as follows:

One single-face direction sign on one post	\$12.00
Two single-face direction signs on one post, signs set at right angles	20.00
One double-face direction sign on one post, boxed over between the two faces	21.00
Two double-face direction signs on one post, boxed over between the two faces	32.00
One town-limit map sign	95.00
One State-line motor vehicle law sign	347.50

The same contractor who is erecting the signs also has a contract to keep them constantly in good repair by annual maintenance. For this service he is to receive \$3.50 per year for each small direction sign and \$20 per year for each map sign.

(Continued from page 16.)

per foot, making the final cost \$1.40. This cost can probably be reduced on future work, as contractors now know just what is to be done and improved equipment and methods can be devised.

For purposes of comparison it may be added that the cost of the similar guard fence erected with wooden posts ranges from 85 cents to \$1.25 per linear foot. In the new type 72 per cent of the total expense is for the concrete posts, and this portion of the construction can be considered as permanent. If the rails are kept painted, no other maintenance should be required for many years.

FINE PARTICLES REMOVED FROM SAND BY CENTRIFUGAL BLOWER.

By C. H. Sweetser, District Engineer, Bureau of Public Roads.

A unique method of treating a local sand to make it conform to the specifications for a concrete road has been adopted by the engineers in charge of California Federal-aid project No. 41. The project is located in the desert between the Imperial and Coachella valleys, and materials for both fine and coarse aggregate were obtainable locally.

Near the south end of the project, however, no sand could be found which would conform to the requirements of the specification, which prescribed that the fine aggregate should contain no more than 5 per cent of material which would pass a 100-mesh sieve. The local sand analyzed in the neighborhood of 15 to 20 per cent, entirely too high a percentage to permit its use.

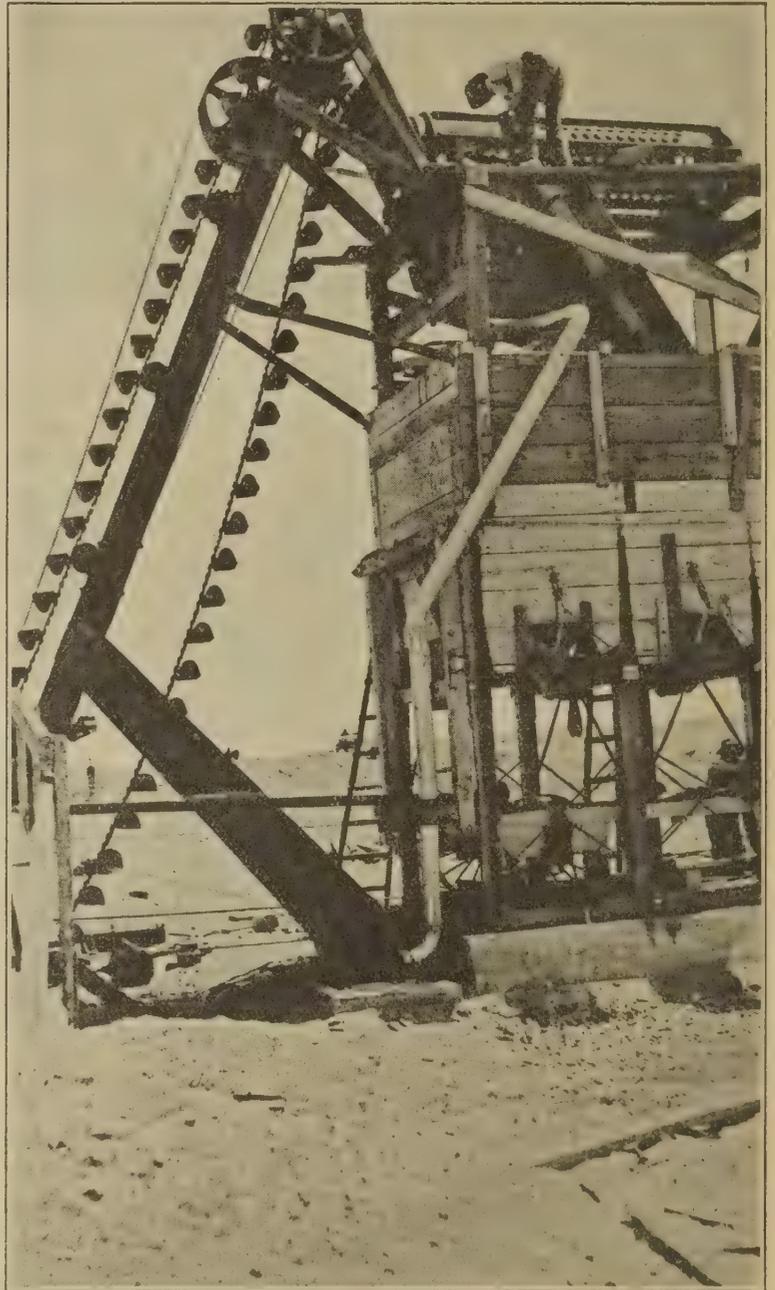
Instead of falling back upon the customary resort and transporting suitable sand from another locality, the engineers turned local conditions to their advantage and devised a plant for blowing the fine particles from the sand. This was made possible by the extreme aridity of the section traversed by the highway, a section in which the summer temperature sometimes mounts to 120° in the shade. In consequence the sand is fully as dry as if it had been treated in a laboratory drying oven.

DEVICE IS SIMPLE AND INEXPENSIVE.

The device, which is shown in the illustration on this page, is simplicity itself. It consists of an ordinary conveyor which lifts the sand to a revolving screen through which the material which will pass a $\frac{1}{4}$ -inch mesh is discharged into a hopper under the screen. The hopper collects the screened sand and discharges it through a narrow opening 2 inches wide by 13 inches long into the storage bin below. In falling from the hopper to the bin the sheet of sand passes directly in front of a nozzle which directs against it a current of air from a centrifugal air blower. By means of a pressure regulator at the blower the velocity of the air at the nozzle can be so controlled as to blow from the falling sand any desired percentage of the finer material. By trial regulation of the air current and correlated testing of the sand it is a simple matter to reduce the fine material content to a percentage which will conform to the specified limit of 5 per cent.

The blower is operated by a belt from the same gas engine which operates the conveyor and revolving screen. The whole device is compact and inexpensive and the result is a satisfactory fine aggregate obtained at less cost than it could have been by any other method.

The success of the plan depends, of course, upon the dryness of the sand. Under ordinary conditions sand would be too damp to make the operation of a plant



DEVICE FOR BLOWING FINE PARTICLES FROM SAND FOR CONCRETE ROAD.

of this kind practicable unless the sand were dried, which might so increase the cost of the treatment as to make the importation of suitable material preferable.

Incidentally, if we may be permitted to indulge a natural propensity to moralize, it is just by such evidences of ability to turn natural conditions to advantage that the real engineer is distinguished from the timeserver. Under conditions such as prevailed on California project No. 41 the stereotyped method of complying with the specification requirements would have been to import suitable material from another locality to be used instead of or by mixture with the local material.

GRADING TO HELP NATURE CLEAR THE ROADS OF SNOW.

By B. B. Hauser, Highway Engineer, Bureau of Public Roads.

IN the midst of the prevailing hot spell readers of PUBLIC ROADS may find relief in turning for a moment to the consideration of a problem which we are accustomed to associate with cooler weather—the subject of snow removal. Those who are not inclined to spend a moment merely in the enjoyment of the refreshing atmosphere which clings about the subject may be assured that the phase of it which is to be presented is not by any means as untimely as the season suggests.

In examining the earlier Federal-aid projects submitted by Wyoming, the reviewers at the Bureau of Public Roads

discovered what appeared to be a flagrant disregard for the proper balancing of cut and fill in the earthwork. Everywhere the grade line was found to be above the natural surface of the ground, never below it. Fills were discovered even where the ground profile showed a natural knoll, and no source of material for the embankment appeared anywhere except by opening borrow pits.

The apparent defects were called to the attention of the Wyoming department, which responded with the explanation that the grades were kept high in order to utilize the winter winds for snow removal. For six or even seven months each year there is likely to be snow, which is generally accompanied by wind. It is well known that any portion of a roadway which is below the surface of the surrounding ground will drift full of snow to a depth equal to the height of any near-by object above the grade. When this happens the State is put to heavy expense for snow removal or traffic comes to a standstill. In a State like Wyoming, where the snow remains on the ground for such long periods and where distances are long, the expense of snow removal would be exceptionally heavy, and of doubtful economy on account of the relatively light traffic.

The Wyoming plan is to build the grade at an elevation which is slightly above the sagebrush and weeds, and above the normal surface of the snow as it would fall on the adjacent land without wind. This can not be accomplished in every case, but in flat or gently



SHOWING THE SNOW SWEEPED FROM THE SURFACE OF THE ELEVATED ROAD BY THE WIND, WHILE THE OLD PRAIRIE ROAD TO THE RIGHT IS CLOGGED WITH DRIFT.

rolling country the Wyoming department believes that the wind will keep the roadbed practically clear of snow, if the conditions be carefully studied and the grade be placed sufficiently high.

In many cases, in order to accomplish results it may be necessary, as previously noted, to build a fill even on the top of the knolls and high points. The method involves greater grading costs, but there is much to recommend it if the results are sufficient to justify the greater expense for grading.

RESULTS JUSTIFY EXPENSE.

Of this there seems to be little doubt after a study of some of the roads last winter. The illustration shown on this page is one of a number of photographs that were taken on Federal-aid project No. 85, near Casper, Wyo. This is one of the projects which has been approved by the Bureau with the grade laid in the manner previously described. The project runs through a flat and gently rolling country for a distance of about 10 miles, and the grade is laid throughout approximately 1 foot above the ground surface on each side. A few days prior to the inspection about 4 inches of snow had fallen. Subsequently the wind had blown nearly at right angles to the road, with the result shown in the picture. The efficacy of the elevated grade is indicated clearly by comparing the clean-swept surface of the new road with the depressed, snow-clogged prairie road at the right.

STATUS OF FEDERAL AID, JUNE 30, 1921

At the close of the fifth fiscal year since the passage of the Federal-aid road act, which was signed by the President on July 11, 1916, the States and Federal Government had completed 7,469 miles of road and 17,977 miles additional were under construction and half completed. Including the work completed on the projects still under construction the States had completed work which entitles them to draw on the Federal Treasury for \$118,915,515. That is the amount which has actually been earned in payment for work performed. In addition to this amount there is a balance, allotted to projects now under construction, which has not yet been earned by completion of work amounting to \$66,375,636, so that the total amount of Federal money involved in the projects now under construction or completed amounts to \$185,291,151, about 70 per cent of all the money which Congress has thus far appropriated.

The sum of the two appropriations which have been made is \$275,000,000. Of this amount 3 per cent is

reserved under the law for administrative expenses of the Government, so that the amount available for distribution to the States has been \$266,750,000. Of this amount there is now only \$18,793,544 remaining unobligated; the balance of \$247,956,456 has been set aside to be paid to the States upon completion of projects which the Government has approved. As stated above, \$118,915,515 of this amount has already been earned.

The unobligated balance referred to is the whole amount which has not been taken up by all the States. Twelve of the States have obligated their entire allotment and now have no unobligated balance at all. Several other States have only enough unobligated to build a mile or two of road, and New Jersey has only 55 cents.

The progress during the last fiscal year was naturally far greater than in any preceding year. A year ago the projects which were entirely completed totaled 1,677 miles in length and there were projects under

TABLE 1.—Financial statement as of May 31, 1921.

State.	Total apportionment of Federal aid.	Federal aid in work under construction and completed. ¹	Federal aid available for new contracts.	Federal aid in completed work. ²	Federal aid in uncompleted work on projects under construction.	Amounts Federal aid paid States.	Balance Federal aid earned by States.
Alabama.....	\$5,776,552	\$1,834,338	\$3,942,214	\$1,536,342	\$297,996	\$1,352,056	\$184,286
Arizona.....	3,771,351	3,002,845	768,506	2,576,399	426,446	1,141,043	1,435,356
Arkansas.....	4,619,929	3,386,604	1,233,325	1,879,253	1,507,351	1,056,023	823,230
California.....	8,384,354	4,477,884	3,906,470	2,877,971	1,599,913	1,883,385	994,586
Colorado.....	4,780,064	2,972,618	1,807,446	1,719,787	1,252,831	1,335,354	384,433
Connecticut.....	1,689,324	981,823	707,501	526,700	455,123	168,647	358,053
Delaware.....	447,655	447,655	-----	404,455	43,200	331,366	73,089
Florida.....	3,150,112	2,355,951	794,161	1,334,848	1,021,103	447,025	887,823
Georgia.....	7,407,579	7,008,237	399,342	5,058,206	1,950,031	4,054,811	1,003,395
Idaho.....	3,360,389	3,270,926	89,463	2,371,326	899,600	1,584,306	787,020
Illinois.....	12,024,267	11,807,906	216,361	10,129,167	1,678,739	6,893,718	3,235,449
Indiana.....	7,415,293	2,869,794	4,545,499	1,816,690	1,053,104	978,053	838,632
Iowa.....	7,939,343	7,191,906	747,437	4,124,190	3,067,716	1,677,133	2,447,057
Kansas.....	7,895,309	5,723,256	2,172,053	2,907,624	2,815,632	1,670,775	1,236,849
Kentucky.....	5,370,065	3,258,586	2,111,479	1,796,356	1,462,230	1,199,093	597,263
Louisiana.....	3,742,525	3,739,976	2,549	2,536,306	1,203,670	1,962,856	573,450
Maine.....	2,645,964	2,160,431	485,533	959,337	1,201,094	501,789	457,548
Maryland.....	2,390,749	2,207,867	182,882	1,776,300	431,567	1,477,779	298,521
Massachusetts.....	4,052,565	2,015,597	2,036,968	1,292,107	723,490	953,095	339,012
Michigan.....	7,961,296	4,885,996	3,075,300	2,710,943	2,175,053	1,463,509	1,247,434
Minnesota.....	7,815,383	6,930,076	885,307	4,946,190	1,983,886	4,394,092	552,098
Mississippi.....	4,951,542	2,881,460	2,070,082	1,528,595	1,352,865	992,554	536,041
Missouri.....	9,322,076	4,895,261	4,426,815	2,050,662	2,844,599	773,905	1,276,757
Montana.....	5,498,827	3,394,964	2,103,863	2,461,606	933,358	1,807,026	654,580
Nebraska.....	5,866,762	3,827,202	2,039,560	3,181,132	646,070	2,112,268	1,068,864
Nevada.....	3,527,276	1,451,007	2,076,269	1,187,382	263,625	796,167	391,215
New Hampshire.....	1,143,089	943,130	199,959	850,804	92,326	781,695	69,109
New Jersey.....	3,265,299	1,660,564	1,604,735	1,226,995	433,569	856,626	370,369
New Mexico.....	4,389,795	2,083,799	2,305,996	1,455,427	628,372	1,092,296	363,131
New York.....	13,688,802	3,579,592	10,109,210	690,855	2,888,737	298,308	392,547
North Carolina.....	6,270,691	6,074,188	196,503	4,238,394	1,835,794	3,043,818	1,194,546
North Dakota.....	4,222,488	2,873,757	1,346,731	1,456,375	1,419,352	849,916	606,459
Ohio.....	10,202,948	6,806,521	3,396,427	3,571,689	3,234,832	2,815,248	756,441
Oklahoma.....	6,338,246	3,503,710	2,834,536	1,455,927	2,047,783	730,735	725,192
Oregon.....	4,332,178	4,332,178	-----	3,415,884	916,294	2,471,102	944,782
Pennsylvania.....	12,632,644	10,787,479	1,845,165	8,005,338	2,782,141	5,951,688	2,053,650
Rhode Island.....	641,166	550,080	91,086	411,132	138,948	265,050	146,082
South Carolina.....	3,946,618	2,892,956	1,053,662	2,075,454	817,502	1,247,200	828,254
South Dakota.....	4,452,883	3,306,677	1,146,206	1,894,323	1,412,354	903,454	990,869
Tennessee.....	6,228,138	5,431,925	796,213	1,701,793	3,730,132	455,761	1,246,032
Texas.....	16,100,405	11,393,425	4,706,980	7,009,224	4,384,201	3,722,514	3,286,710
Utah.....	3,117,206	1,813,395	1,303,811	997,137	816,258	484,294	512,843
Vermont.....	1,242,104	671,740	570,364	332,423	339,317	184,169	148,254
Virginia.....	5,451,730	3,566,729	1,885,001	2,146,964	1,419,765	1,350,124	796,800
Washington.....	3,971,676	3,901,685	69,991	3,706,284	195,401	3,392,946	313,338
West Virginia.....	2,922,504	2,679,925	242,579	1,850,574	829,351	1,414,409	436,165
Wisconsin.....	7,004,281	4,670,162	2,334,119	2,786,201	1,883,951	1,845,327	940,874
Wyoming.....	3,378,558	2,785,368	593,190	1,946,444	838,924	1,330,917	415,527
Total.....	266,750,000	185,291,151	81,458,849	118,915,515	66,375,636	78,695,430	40,220,085

¹ Includes projects entirely completed and paid for.

² Includes completed portions of projects under construction.

TABLE 2.—Status of construction work, June 30, 1921.

State.	Projects under construction.					Projects on which construction is completed.		
	Total estimated cost.	Federal aid.	Miles.	Per cent complete.	Federal aid earned.	Total estimated cost.	Federal aid.	Miles.
Alabama.....	\$1,242,501.49	\$595,993.06	95.00	50	\$297,996	\$2,524,645.00	\$1,238,345.00	288.00
Arizona.....	¹ 3,816,863.24	¹ 1,705,781.96	¹ 174.98	75	1,279,336	2,659,905.80	1,297,063.30	147.48
Arkansas.....	10,245,304.00	3,207,125.97	875.00	53	1,699,776	453,758.99	179,477.56	67.00
California.....	5,423,434.40	2,711,717.14	229.70	41	1,111,804	3,663,711.36	1,766,167.00	198.09
Colorado.....	4,192,461.52	2,053,821.96	283.16	39	800,991	1,890,644.42	918,795.84	123.88
Connecticut.....	2,433,932.00	928,823.05	51.19	51	473,700	125,660.79	53,000.00	5.30
Delaware.....	210,143.11	54,000.00	6.00	20	10,800	1,694,315.00	393,654.83	28.13
Florida.....	¹ 4,658,903.45	¹ 2,219,786.86	132.62	54	1,198,684	272,404.52	136,164.41	34.03
Georgia.....	10,265,001.27	4,534,955.40	838.00	57	2,584,924	5,334,778.63	2,473,282.06	281.87
Idaho.....	5,274,304.30	2,498,889.56	386.85	64	1,599,290	1,631,840.56	772,036.27	149.00
Illinois.....	12,265,218.29	5,246,058.26	334.00	68	3,567,319	13,574,179.45	6,561,848.46	411.10
Indiana.....	4,959,943.48	2,449,076.49	137.11	57	1,395,973	866,417.26	420,716.84	21.30
Iowa.....	16,193,999.67	6,527,055.52	1,130.49	53	3,459,340	1,616,040.00	664,850.00	168.00
Kansas.....	18,429,303.53	4,772,256.92	411.14	41	1,956,625	2,374,383.27	950,999.49	91.13
Kentucky.....	6,041,992.99	2,924,458.50	255.13	50	1,462,229	729,529.85	334,126.70	28.00
Louisiana.....	¹ 6,661,925.12	3,009,176.11	¹ 523.67	60	1,805,506	1,521,931.00	730,800.00	150.00
Maine.....	3,715,704.05	1,792,678.27	105.57	33	591,584	735,562.65	367,752.87	28.43
Maryland.....	1,864,932.46	829,985.91	59.92	48	398,369	2,836,001.97	1,377,930.65	103.23
Massachusetts.....	3,187,270.10	1,391,327.46	81.61	48	667,837	1,352,398.72	624,270.22	47.71
Michigan.....	8,319,920.70	3,954,641.02	280.24	45	1,779,588	1,968,132.75	931,355.03	105.25
Minnesota.....	12,834,977.39	4,959,714.49	1,096.21	60	2,975,828	5,113,060.86	1,970,362.36	648.82
Mississippi.....	5,075,626.52	2,459,753.74	374.92	45	1,106,889	865,213.87	421,705.82	120.23
Missouri.....	10,452,528.45	4,740,998.20	572.26	40	1,896,399	473,754.62	154,262.73	53.61
Montana.....	4,741,835.78	2,333,395.74	486.32	60	1,400,038	2,476,025.76	1,061,568.00	149.00
Nebraska.....	4,349,642.52	2,153,566.34	735.25	70	1,507,496	3,507,125.93	1,673,635.81	668.65
Nevada.....	1,909,789.25	941,517.42	91.87	72	677,892	1,063,622.17	509,490.07	103.92
New Hampshire.....	577,036.56	288,518.20	36.26	68	196,192	1,363,494.28	654,611.77	88.64
New Jersey.....	2,485,050.37	788,307.07	38.94	45	354,738	2,207,120.30	872,257.31	56.24
New Mexico.....	2,732,051.47	1,366,025.66	317.01	54	737,654	1,439,194.88	717,772.75	161.53
New York.....	7,988,025.15	3,438,972.56	185.32	16	550,236	281,237.00	140,619.00	10.34
North Carolina.....	9,553,000.22	4,589,485.86	646.63	60	2,753,692	3,399,667.46	1,484,701.58	269.38
North Dakota.....	5,513,764.58	2,729,580.16	873.84	48	1,310,198	302,621.58	146,176.58	122.10
Ohio.....	15,319,521.18	4,976,663.98	404.22	35	1,741,832	5,485,627.62	1,829,857.18	182.00
Oklahoma.....	7,450,828.02	3,150,435.93	232.14	35	1,102,653	726,902.67	353,273.68	14.88
Oregon.....	6,460,001.16	3,054,314.25	298.19	70	2,138,020	2,649,165.09	1,277,864.01	190.00
Pennsylvania.....	17,106,234.52	6,048,132.53	298.49	54	3,265,992	11,195,828.92	4,739,346.08	254.17
Rhode Island.....	962,593.14	396,995.01	21.64	65	258,047	310,571.40	153,085.39	10.30
South Carolina.....	5,110,561.19	2,335,719.35	417.23	65	1,518,217	1,199,357.00	557,237.30	103.94
South Dakota.....	5,779,726.38	2,882,354.85	616.94	51	1,470,001	848,643.49	424,321.71	99.99
Tennessee.....	10,874,639.14	5,405,988.40	394.06	31	1,675,856	54,738.00	25,937.00	2.00
Texas.....	23,485,280.13	8,947,359.19	1,631.97	51	4,563,158	5,812,851.01	2,446,065.81	682.92
Utah.....	3,552,074.51	¹ 1,774,474.49	¹ 225.33	54	958,216	77,842.12	38,921.06	9.28
Vermont.....	1,113,505.52	556,258.01	42.54	39	216,941	230,965.18	115,482.31	10.48
Virginia.....	4,871,305.08	2,406,381.72	200.44	41	986,617	2,368,177.19	1,160,346.95	174.18
Washington.....	² 2,554,177.01	¹ 1,149,415.91	85.33	83	954,015	5,838,365.75	2,752,269.08	275.45
West Virginia.....	³ 4,844,248.54	³ 2,182,499.60	³ 231.84	60	1,353,149	1,062,085.11	497,424.72	55.38
Wisconsin.....	9,964,353.28	3,694,042.04	644.60	49	1,816,081	2,962,966.01	976,120.34	255.12
Wyoming.....	4,494,656.35	2,151,085.70	386.49	61	1,312,162	1,305,186.52	634,282.46	219.91
Total.....	321,560,092.58	135,309,515.82	17,977.40	50	68,933,880	112,447,653.78	49,981,635.39	7,469.44

¹ Cost of work under construction plus work completed less than last month because of modifications in agreements.

² Correction from last month.

³ Reductions due to cancellation of projects on request of State highway department.

construction aggregating 14,940 miles which were 30 per cent complete. In one year's time the aggregate length of completed projects has been increased to 7,469 miles, and the mileage of projects under construction has increased to 17,977 miles, which is reported as 50 per cent complete.

The money earned by completion of work has grown from \$40,097,881 a year ago to \$118,915,515 at the end of this fiscal year. The amount earned during the year was \$78,817,634, which was nearly twice as great as the amount earned during the four years preceding.

The new projects submitted during the year bring the total amount of Federal aid obligated up to

\$247,956,456, as compared with \$109,830,366 which was the amount obligated on June 30, 1920. At this rate it is clear that the small balance of \$18,000,000 still unobligated will be taken up in a very short time.

The month of June was a banner month in every way. The mileage of completed projects increased by more than 1,200 miles, more than twice the amount which was reported for the month of May.

The amount of Federal aid earned was \$7,751,494, bringing the total amount earned up to \$118,915,515; and the funds allotted to work actually under construction grew from \$171,620,226 on May 31 to \$185,291,151, an increase of \$13,670,925.

FEDERAL-AID ALLOWANCES.

PROJECT STATEMENTS APPROVED IN JUNE, 1921.

State.	Project No.	County.	Length in miles.	Type of construction.	Date approved.	Total estimated cost.	Federal aid.
Alabama	78	Tallapoosa	11.590	Bituminous macadam	June 15	\$286,424.35	\$143,212.17
	87	Limestone	14.617	do.	June 8	396,393.25	198,196.62
	101	Butler	10.756	Sand-clay	June 14	57,615.82	28,807.91
California	102	Chambers	4.767	Gravel	June 22	60,405.51	30,202.75
	69	Nevada	14.81	Oiled macadam	June 2	265,320.00	132,660.00
	76	Solano	11.930	Reinforced concrete	do.	435,683.60	217,841.80
	80	Shasta	13.17	Gravel	June 20	213,785.00	106,892.50
Colorado	129	Adams	4.419	Concrete	June 22	177,849.65	88,380.00
	131	Adams, Arapahoe	.833	Concrete shoulders	June 22	32,588.05	16,294.02
	171	Delta	6.500	Gravel	June 13	69,785.17	34,892.58
Connecticut	8	Windham	3.900	Bituminous macadam	June 23	181,750.25	78,000.00
Florida	32	Nassau	10.000	do.	June 20	325,149.00	163,574.50
	33	Alachua	12.601	do.	June 23	398,125.75	199,062.87
Kansas	79	Montgomery	3.000	W. B. macadam	June 9	142,806.40	60,000.00
	80	Chase	.507	Brick or concrete	June 8	25,979.58	7,500.00
	81	Allen	4.000	do.	June 14	172,601.00	60,000.00
	82	Atchison	6.620	Earth	do.	41,250.00	19,860.00
	83	do.	15.000	do.	June 13	154,550.00	30,000.00
	84	Brown	6.900	do.	do.	42,973.98	16,000.00
Maine	36	Washington	6.002	Bituminous macadam	June 14	220,191.40	110,095.70
	42	Penobscot	3.559	Concrete	do.	150,340.85	71,180.00
Maryland	22	Caroline	12.540	do.	June 1	186,345.90	143,172.80
Massachusetts	58	Middlesex	1.345	Bituminous macadam	June 15	104,905.90	26,900.00
	59	Berkshire	.786	do.	do.	52,123.50	15,720.00
	60	Essex	1.907	do.	June 14	98,230.00	42,970.00
	61	Worcester	5.393	Bituminous macadam	June 14	318,384.00	107,860.00
	64	Norfolk	1.065	Reinforced concrete	June 18	60,885.00	21,300.00
Michigan	60	Emmet, Cheboygan	15.442	Gravel	June 20	243,888.70	129,944.35
Minnesota	215	Dakota	3.190	do.	June 18	18,831.12	5,000.00
Montana	144	Valley	12.000	do.	June 16	81,235.00	40,617.50
	160	Yellowstone	30.000	do.	June 14	273,208.65	136,604.32
Nebraska	174	Buffalo	2.800	do.	May 31	25,241.16	13,120.58
	175	Lancaster	23.700	Earth	June 22	83,490.00	41,745.00
	179	Sarpy	Bridge	Concrete	June 18	14,850.00	7,425.00
Nevada	45	Churchill	5.000	Gravel	June 8	88,176.00	44,088.00
New Hampshire	135	Merrimack	1.010	Reinforced concrete	May 20	43,725.00	20,200.00
New Jersey	26	Monmouth	3.996	Concrete	June 14	155,460.14	79,920.00
	32	Warren	10.965	Macadam	do.	790,832.59	219,300.00
New York	109	Essex	5.500	Bituminous macadam	June 25	313,500.00	109,725.00
	120	do.	3.400	do.	June 27	136,000.00	68,000.00
	123	Albany	3.530	Concrete	May 31	136,200.00	68,100.00
	138	Orleans	2.400	Bituminous macadam	June 15	136,800.00	47,880.00
	154	Columbia	1.140	Reinforced concrete	June 27	45,600.00	22,800.00
	160	Schenectady	4.510	Bituminous macadam	June 14	101,640.00	50,820.00
North Dakota	114	Pembina	11.000	Earth	June 22	50,820.00	25,410.00
Ohio	160	Seneca	3.883	Bituminous macadam or W. B. macadam	June 9	137,000.00	68,500.00
	200	Putnam	1.710	Rock asphalt	do.	93,000.00	30,000.00
	203	Crawford	6.706	Brick on concrete	do.	318,000.00	134,000.00
	204	do.	2.034	do.	do.	101,000.00	40,000.00
	207	Licking	4.051	Concrete	May 31	250,000.00	58,800.00
Oklahoma	208	Erie	2.573	do.	June 22	123,000.00	30,000.00
	18R	Muskogee	14.812	Gravel	June 2	440,732.32	220,350.00
	48	Marshall	13.600	do.	June 16	217,914.00	108,957.00
	52	Muskogee-Sequoyah	Bridge	Concrete	June 9	384,369.86	192,184.93
South Carolina	53	Ocmulgee	12.000	Concrete	June 27	674,914.34	110,000.00
	75	Oconee	5.404	Top soil	June 9	72,000.00	31,322.21
	97	Anderson	11.350	do.	June 14	46,185.20	23,092.60
	118	Clarendon	Bridge	do.	June 8	14,961.65	7,480.82
South Dakota	121	Kershaw	4.000	Sand-clay	June 18	15,785.00	7,892.50
	79	Butte	Bridge	Reinforced concrete	do.	34,928.73	17,464.36
	80	Pennington	.030	do.	do.	14,356.76	7,178.38
Texas	243	Kerr	31.850	Gravel macadam	May 31	270,111.32	100,000.00
	245	Hudspeth	24.810	Gravel	do.	200,000.00	100,000.00
	249	Wheeler	Bridge	do.	June 22	150,541.60	34,500.00
	250	Hidalgo	34.300	Gravel	do.	251,618.84	62,928.45
Utah	251	Blanco	13.900	do.	June 24	70,611.51	17,500.00
	31	Weber	Bridge	Concrete	May 28	118,002.97	59,001.48
	32	Weber-Box Elder	2.230	do.	do.	75,591.61	37,795.80
	35	Utah	1.770	do.	do.	50,514.88	25,257.44
	36	do.	1.830	do.	May 31	50,410.36	25,205.18
Virginia	38	Accomac	3.910	Bituminous macadam	May 28	223,121.25	111,560.62
	69	Augusta	3.420	W. B. macadam	June 16	176,367.35	138,183.67
	90	Franklin	7.640	Top soil	June 22	93,200.58	46,600.00
	93	Roanoke	4.170	W. B. macadam	do.	68,866.16	34,433.08
	97	Wise	.255	Bituminous macadam	June 16	35,618.00	5,100.00
	98	Halifax-Charlotte	14.600	Soil	May 31	104,857.50	52,428.75
	101	Bath-Aleghany	7.390	W. B. macadam	June 9	125,774.00	62,887.00
	105	Albemarle	12.000	Bituminous macadam	do.	376,275.46	188,137.73
	109	Louisa	25.500	Top soil	June 22	139,365.16	69,682.58
	115	Albemarle	3.420	Bituminous macadam	do.	108,168.72	54,084.36
	116	Surry	12.880	Soil	May 31	104,967.50	52,483.75
	121	Southampton	6.510	Concrete	do.	239,818.83	119,909.41
	122	Lee	5.050	W. B. macadam	June 22	127,769.37	63,884.68
	127	Prince Edward-Nottoway	7.670	Top soil	June 27	54,975.14	27,487.57
West Virginia	111	Jefferson	3.000	Bituminous macadam	June 14	44,895.40	22,447.70
Wisconsin	128	Portage	2.060	Concrete	May 24	102,957.53	40,000.00
	185	Barron	8.620	Gravel	June 8	70,043.33	30,000.00
	188	Burnett	6.830	do.	June 28	100,911.41	45,000.00
	189	Chippewa	6.010	Earth	May 31	27,647.21	10,000.00
	190	do.	2.810	do.	May 28	20,282.05	9,000.00
	198	Dane	5.945	do.	May 24	53,072.25	20,000.00
	202	Dunn	2.410	do.	June 8	20,443.50	5,186.88
	204	do.	3.850	do.	do.	30,987.00	14,500.00
	205	Eau Claire	4.240	Shale	do.	44,990.00	14,000.00

¹ Revised statement. Amounts given are increases over those in the original statement.

² Revised statement. Amounts given are decreases over those in the original statement.

PROJECT STATEMENTS APPROVED IN JUNE, 1921—Continued.

State.	Project No.	County.	Length in miles.	Type of construction.	Date approved.	Total estimated cost.	Federal aid.	
Wisconsin (continued)	211	Grant	4.790	Earth	May 28	\$72,586.25	\$30,000.00	
	213	Jackson	1.180	Top soil	June 8	29,852.37	10,000.00	
	221	Lafayette	6.090	Earth	do	44,027.50	15,000.00	
	224	Marathon	13.900	Gravel	May 28	189,262.70	70,000.00	
	226	Marinette	8.650	Earth	June 8	105,088.50	30,000.00	
	240	Rusk	7.960	Gravel	June 2	65,881.75	30,000.00	
	241	St. Croix	1.280	Earth	June 8	17,979.50	7,000.00	
	242	do	1.420	Gravel	June 4	12,350.80	5,500.00	
	244	Sawyer	5.180	Earth	May 31	28,376.81	11,000.00	
	245	do	7.750	Top soil	June 8	62,084.00	30,000.00	
	248	Taylor	5.600	Earth	June 4	40,924.59	20,000.00	
	253	Waushara	6.530	Gravel	May 28	65,847.32	24,000.00	
	254	Wood	.950	do	May 24	12,295.83	5,000.00	
	256	Monroe	3.540	Shale	June 8	75,229.00	33,518.69	
	259	Marinette	4.400	Concrete	do	169,356.00	56,499.55	
	Wyoming	74	Converse		Gravel	June 14	141,140.00	120,570.00
		89	Natrona		Earth	June 20	130,360.00	115,180.00

¹ Revised statement. Amounts given are decreases over those in the original statement.

PENNSYLVANIA HIGHWAY DEPARTMENT LAYS PLANS FOR THE FUTURE WIDENING OF ITS MAIN HIGHWAYS

WHILE no immediate construction activities will result, the State highway department of Pennsylvania for the last two years has been making a study of traffic conditions on thoroughfares leading to important municipalities of Pennsylvania, and eventually steps will be taken to increase the width of the arteries leading into the larger cities of the State.

It is apparent that with the normal increase in the registration of motor vehicles the present width of highways will be entirely inadequate within a few years. At the instance of the State highway department the 1921 legislature gave consideration to this matter and enacted legislation which received the approval of the governor and which will give the State highway department power to extend the width of important thoroughfares so that they will be adequate for the safety of road users.

It is not the purpose of the State highway department immediately to widen these highways, but merely to make a survey of possible future traffic so that lines may be laid down for the guidance of individuals or others who are contemplating improvements along these routes. The proceeding is similar to that followed by municipalities which establish building lines along undeveloped streets.

The State highway department hopes by this procedure to save the enormous expenditure which will necessarily be entailed in widening arterial roadways after improvements have been completed. To this end

it is working in conjunction with the suburban association of the main line, whose membership is composed of students of the highway problem in Philadelphia and the adjacent counties of Delaware, Montgomery, and Bucks.

Commissioner Sadler and the engineering forces of the department are looking ahead 15 and 20 years to the traffic which will then be using the roads of Pennsylvania. The recent legislature gave the department authority to extend the width of highways to 120 feet. That a number of arterial thoroughfares will be extended to that width eventually is a certainty. If this were postponed and owners of adjoining property had made improvements, the cost would be extraordinarily high, as was the cost of opening the parkway in Philadelphia several years ago. Commissioner Sadler believes that by setting the lines now property owners if they build will build back of those lines.

The great increase in motor vehicle traffic within the limits of the larger municipalities of Pennsylvania will eventually necessitate the building of thoroughfares skirting these municipalities and wide enough to accommodate several streams of traffic going in both directions. Within a few years it will be unwise to send heavy trans-Pennsylvania traffic into Philadelphia and Pittsburgh, for example, inasmuch as addition of this traffic will add to the congestion of the down-town districts. Consequently wide roads must be provided around the larger cities so that traffic may be accommodated.



Owing to the necessarily limited edition of this publication it will be impossible to distribute it free to any persons or institutions other than State and county officials actually engaged in the planning or construction of highways, instructors in highway engineering, periodicals upon an exchange basis, and Members of both Houses of Congress. Others desiring to obtain "Public Roads" can do so by sending 10 cents for a single number or \$1.00 per year to the Superintendent of Documents, Government Printing Office, Washington, D. C.

ROAD PUBLICATIONS OF BUREAU OF PUBLIC ROADS.

Applicants are urgently requested to ask only for those publications in which they are particularly interested. The Department can not undertake to supply complete sets, nor to send free more than one copy of any publication to any one person. The editions of some of the publications are necessarily limited, and when the Department's free supply is exhausted and no funds are available for procuring additional copies, applicants are referred to the Superintendent of Documents, Government Printing Office, this city, who has them for sale at a nominal price, under the law of January 12, 1895. Those publications in this list, the Department supply of which is exhausted, can only be secured by purchase from the Superintendent of Documents, who is not authorized to furnish publications free.

REPORTS

- *Report of the Director of the Office of Public Roads for 1917. 6c.
- Report of the Director of the Bureau of Public Roads for 1918.
- Report of the Chief of the Bureau of Public Roads for 1919.
- Report of the Chief of the Bureau of Public Roads for 1920.

DEPARTMENT BULLETINS.

- Dept. Bul. *105. Progress Report of Experiments in Dust Prevention and Road Preservation, 1913. 5c.
- *136. Highway Bonds. 25c.
- 220. Road Models.
- *230. Oil Mixed Portland Cement Concrete. 10c.
- *249. Portland Cement Concrete Pavements for Country Roads. 15c.
- 257. Progress Report of Experiments in Dust Prevention and Road Preservation, 1914.
- 314. Methods for the Examination of Bituminous Road Materials.
- 347. Methods for the Determination of the Physical Properties of Road-Building Rock.
- *348. Relation of Mineral Composition and Rock Structure to the Physical Properties of Road Materials. 10c.
- *370. The Results of Physical Tests of Road-Building Rock. 15c.
- *373. Brick Roads. 15c.
- 386. Public Road Mileage and Revenues in the Middle Atlantic States, 1914.
- 387. Public Road Mileage and Revenues in the Southern States, 1914.
- 388. Public Road Mileage and Revenues in the New England States, 1914.
- *389. Public Road Mileage and Revenues in the Central, Mountain, and Pacific States, 1914. 15c.
- 390. Public Road Mileage in the United States, 1914. A summary.
- *393. Economic Surveys of County Highway Improvement. 35c.
- 407. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1915.
- 414. Convict Labor for Road Work.
- *463. Earth, Sand-Clay, and Gravel Roads. 15c.
- 532. The Expansion and Contraction of Concrete and Concrete Roads.
- *537. The Results of Physical Tests of Road-Building Rock in 1916, Including all Compression Tests. 5c.
- 555. Standard Forms for Specifications, Tests, Reports, and Methods of Sampling for Road Materials.
- 583. Reports on Experimental Convict Road Camp, Fulton County, Ga.
- 586. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1916.
- *660. Highway Cost Keeping. 10c.
- 670. The Results of Physical Tests of Road-Building Rock in 1916 and 1917.
- *691. Typical Specifications for Bituminous Road Materials. 15c.
- 704. Typical Specifications for Nonbituminous Road Materials.
- *724. Drainage Methods and Foundations for County Roads. 20c.

- *Public Roads, Vol. I, No. 11. Tests of Road-Building Rock in 1918.
- *Public Roads, Vol. II, No. 23. Tests of Road-Building Rock in 1919. 15c.

DEPARTMENT CIRCULAR.

- No. 94. TNT as a Blasting Explosive.

FARMERS' BULLETINS.

- F. B. *338. Macadam Roads. 5c.
- 505. Benefits of Improved Roads.
- 597. The Road Drag.

*Department supply exhausted.

SEPARATE REPRINTS FROM THE YEARBOOK.

- Y. B. Sep. 727 Design of Public Roads.
- 739. Federal Aid to Highways, 1917.

OFFICE OF PUBLIC ROADS BULLETINS.

- Bul. *45. Data for Use in Designing Culverts and Short-span Bridges (1913.) 15c.

OFFICE OF PUBLIC ROADS CIRCULARS.

- Cir. *89. Progress Report of Experiments with Dust Preventatives, 1907. 5c.
- *90. Progress Report of Experiments in Dust Prevention, Road Preservation, and Road Construction, 1908. 5c.
- *92. Progress Report of Experiments in Dust Prevention and Road Preservation, 1909. 5c.
- *94. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1910. 5c.
- *99. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1912. 5c.
- *100. Typical Specifications for Fabrication and Erection of Steel Highway Bridges. (1913.) 5c.

OFFICE OF THE SECRETARY CIRCULARS.

- Sec. Cir. 49. Motor Vehicle Registrations and Revenues, 1914.
- *52. State Highway Mileage and Expenditures to January 1, 1915. 5c.
- 59. Automobile Registrations, Licenses, and Revenues in the United States, 1915.
- 63. State Highway Mileage and Expenditures to January 1, 1916.
- *65. Rules and Regulations of the Secretary of Agriculture for Carrying out the Federal Aid Road Act. 5c.
- *72. Width of Wagon Tires Recommended for Loads of Varying Magnitude on Earth and Gravel Roads. 5c.
- 73. Automobile Registrations, Licenses, and Revenues in the United States, 1916.
- 74. State Highway Mileage and Expenditures for the Calendar Year 1916.
- *77. Experimental Roads in the Vicinity of Washington, D. C. 5c.
- Public Roads Vol. I, No. 1. Automobile Registrations, Licenses, and Revenues in the United States, 1917.
- Vol. I, No. 3. State Highway Mileage and Expenditures in the United States, 1917.
- *Vol. I, No. 11. Automobile Registrations, Licenses, and Revenues in the United States, 1918. 15c.
- *Vol. II, No. 15. State Highway Mileage and Expenditures in the United States, 1918. 15c.
- Vol. III, No. 25. Automobile Registrations, Licenses, and Revenues in the United States, 1919.
- Vol. III, No. 29. State Highway Mileage, 1919.
- Vol. III, No. 36. Automobile Registrations, Licenses, and Revenues in the United States, 1920.

REPRINTS FROM THE JOURNAL OF AGRICULTURAL RESEARCH.

- Vol. 5, No. 17, D- 2. Effect of Controllable Variables Upon the Penetration Test for Asphalts and Asphalt Cements.
- Vol. 5, No. 19, D- 3. Relation Between Properties of Hardness and Toughness of Road-Building Rock.
- Vol. 5, No. 20, D- 4. Apparatus for Measuring the Wear of Concrete Roads.
- Vol. 5, No. 24, D- 6. A New Penetration Needle for Use in Testing Bituminous Materials.
- Vol. 6, No. 6, D- 8. Tests of Three Large-Sized Reinforced-Concrete Slabs under Concentrated Loading.
- Vol. 10, No. 7, D-13. Toughness of Bituminous Aggregates.
- Vol. 11, No. 10, D-15. Tests of a Large-Sized Reinforced-Concrete Slab Subjected to Eccentric Concentrated Loads.
- Vol. 17, No. 4, D-16. Ultra-Microscopic Examination of Disperse Colloids Present in Bituminous Road Materials.

